NONNATIVE FISH CONTROL WORKSHOP

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

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Prepared By

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EXECUTIVE SUMMARY

The Upper Colorado River Endangered Fish Recovery Program (UCRRP) convened a Nonnative Fish Control Workshop on February 13–14, 2002, in Grand Junction, Colorado. The purpose of the workshop was to bring together fish researchers and managers to discuss and evaluate nonnative fish control efforts implemented to date in the Upper Colorado River Basin. Information exchanged at the workshop will be used to modify and refine tasks of the Nonnative and Sport Fish Management element of the UCRRP's Recovery Action Plan (RIPRAP). Tasks of this element are designed to reduce negative impacts of problematic nonnative fishes on the endangered Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), and bonytail (*Gila elegans*).

The following conclusions were reached from presentations and discussions at the workshop:

- I&E efforts need to continue to improve to be more effective at targeting the various public groups with appropriate information on the intent, activities, and planning of the nonnative fish control. The nonnative fish control program is in the initial stages of development and evaluation, and the public needs to be advised and informed about the program.
- The 1996 Nonnative Fish Stocking Procedures are too complex to be translated into understandable and enforceable State regulations. It was noted that in all nonnative fish control efforts, there is a need to demonstrate measurable effects of the action.
- Of the 335 ponds investigated to date in the Grand Valley, studies have shown rapid re-invasion of most reclaimed ponds by small cyprinids and green sunfish; limited use of sampled ponds by largemouth bass; and difficulty in maintenance and enforcement of maintenance of outlet screens.
- Based on results at Old Charlie Wash on the Green River, it is feasible to remove large numbers and biomass of nonnative fishes from managed/controlled floodplain depressions, but the effects of this removal on main-channel fish populations is unknown.
- Studies have shown that the Highline Lake Fish Barrier Net is effective at minimizing escapement of nonnative fishes from Highline Lake.
- Efforts in the Yampa River to remove/translocate northern pike have received positive public feedback; data suggest depletive effects in habitats sampled over the sampling period, but average size of northern pike and incidence of attacks on Colorado pikeminnow have increased. Implementation of a bounty reward for northern pike removed through recreational angling may have potential.
- There have been substantial increases in smallmouth bass populations in the Yampa River.
- Fish sampling conducted in the Gunnison River downstream of Hartland diversion since 1996 has not collected northern pike, suggesting that efforts during 1995–1996 to remove the species from this river reach were successful.
- Methods used in 2001 to remove northern pike from the middle Green River appear to be appropriate.

- Population estimates did not show depletive effects from centrarchid removal efforts in the upper Colorado River.
- Studies to date did not show a measurable, lasting reduction in channel catfish populations through mechanical-removal efforts targeting young fish. No alternative methods were identified that would potentially improve chances for successfully reducing channel catfish populations through mechanical removal of young fish. Desolation/Gray canyons is a suspected spawning reach for channel catfish because of the abundance of large boulders and crevices used by cavity spawners.
- Data indicate that angling and electrofishing targeting subadults and adults are effective methods for reducing channel catfish numbers in Yampa Canyon. Yampa Canyon is a suspected spawning reach for channel catfish because of the abundance of large boulders and crevices used by cavity spawners. It is known that young channel catfish produced in the Yampa River (and other tributaries) disperse downstream into the mainstem Green River, then likely migrate back to the tributaries as subadults to recruit into adult populations.
- The group expressed the potential need for channel catfish control programs (similar to those recommended for the Yampa River and Desolation/Gray canyons) in portions of the Duchesne, White, and Colorado rivers.
- Studies to date did not show a measurable, lasting reduction in nonnative cyprinid populations through mechanical-removal efforts; treatment areas were rapidly re-colonized. No alternative methods were identified that would potentially improve chances for successfully reducing nonnative cyprinid populations through mechanical removal.

The following recommendations resulted from the above conclusions:

- Recovery Program's I&E Coordinator work with the I&E Committee and State and local entities (e.g., Yampa Basin Partnership) to improve the message and communications.
- Revise the 1996 Nonnative Fish Stocking Procedures to simplify, clarify, and better reflect the current state of knowledge and proposed future direction of nonnative fish control efforts and regulations.
- Discontinue reclamation of individual ponds in the Grand Valley as a Recovery Program scope of work. Modify current scope of work to identify major source ponds/irrigation returns and place screens to minimize escapement of nonnative fishes to the mainstem Colorado River; explore use of isotopes as an evaluation tool. Screen designs are available that prevent all large fish and most larvae from escaping, and require relatively little maintenance and allow for flood overflow. Anita Martinez (CDOW) has lead; she will work with U.S. Fish and Wildlife Service (USFWS) Grand Junction to identify "hot spots" as sources of predaceous centrarchids (especially largemouth bass).
- Reevaluate Colorado State regulations that require screening the outflows of individual ponds. In particular, enforce screening of the few large source ponds/irrigation returns.

- Revise State regulations to reflect changes in Nonnative Fish Stocking Procedures.
- Continue population estimates of fishes in the Upper Colorado River and, where feasible, use those efforts and results to help assess effects of control measures.
- Do not proceed with large-scale efforts to mechanically remove nonnative fishes (especially centrarchids) from backwaters and other low-velocity habitats used as nurseries by native fishes.
- Continue management of select floodplain depressions to enhance survival of early life stages of native fishes (especially razorback sucker). Include removal of nonnative fishes as a component of the management strategy for select floodplain depressions.
- Continue to maintain and monitor the Highline Lake Fish Barrier Net. Based on the amount of deterioration in net strength since installation in 1999 (about 33%), Recovery Program will need to consider replacement of the net over the next 2–3 years.
- Continue removal and translocation of northern pike from critical habitat in the Yampa River (i.e., downstream of Craig, Colorado, to Dinosaur National Monument).
- Continue removal and translocation of northern pike from the established upper Yampa River sites (upstream of Craig, Colorado). Coordinate with northern pike exclusion assessment (Project No. CAP-31) to prevent confounding effects on exclusion study.
- Explore the possibility of implementing a bounty on northern pike, and if feasible, implement.
- Plan and prepare for removal and translocation of smallmouth bass and channel catfish in the Yampa River during northern pike translocation (potentially implement smallmouth bass and channel catfish removal/translocation at some level in 2002).
- Continue population estimates of fishes in the Yampa River and, where feasible, use those efforts and results to help assess effects of removal/translocation.
- Remove northern pike as encountered from the Gunnison River as part of fish population monitoring and research. No specific removal or translocation project is required.
- Continue mechanical removal of northern pike from the middle Green River (Island Park to confluence of White River). Target flooded areas and tributary mouths (e.g., Cliff Creek, Ashley Creek, Duchesne River, White River) in early spring (April, May, June) to remove northern pike, as well as smallmouth bass, channel catfish, carp, green sunfish, black crappie, bluegill, walleye.
- Do not proceed with large-scale efforts to mechanically remove young channel catfish in the middle and lower Green River.
- Implement removal of channel catfish in Desolation/Gray canyons using fyke nets to target subadults, and electrofishing to target large adult spawners. Also consider angling as a capture method.
- Continue removal of channel catfish in Yampa Canyon by angling and electrofishing.

- Use fyke nets at upper end of Yampa Canyon to intercept and remove adult channel catfish migrating downstream into Yampa Canyon to spawn. Use fyke nets (and possibly angling) at lower end of Yampa Canyon to intercept and remove subadult channel catfish migrating upstream into Yampa Canyon to recruit into the adult spawning population.
- Identify the need for channel catfish control programs in the Duchesne, White, and Colorado rivers, and develop control strategies using programs in the Yampa River and Desolation/Gray canyons as templates.
- Do not proceed with large-scale efforts to mechanically remove nonnative cyprinids from backwaters and low-velocity habitats in the lower Green and Colorado rivers in Utah and in the Colorado River Colorado.

ACKNOWLEDGMENTS–ATTENDEES

The following individuals attended the Upper Colorado River Endangered Fish Recovery Program's Nonnative Fish Control Workshop held on February 13–14, 2002, in Grand Junction, Colorado. Their attendance and input during the workshop were greatly appreciated.

Name	Affiliation
Rick Anderson	Colorado Division of Wildlife
Ron Brunson	Utah Division of Wildlife Resources
Bob Burdick	U.S. Fish and Wildlife Service
Gary Burton	Western Area Power Administration
Tom Chart	U.S. Bureau of Reclamation, Upper Colorado Region
Kevin Christopherson	Utah Division of Wildlife Resources
Tom Czapla	Upper Colorado River Recovery Program, FWS
Bill Davis	EcoPlan Associates (Representing CREDA)
Paul Dey	Wyoming Game and Fish Department
Craig Ellsworth	SWCA Environmental Consultants
Bill Elmblad	Colorado Division of Wildlife
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Glen Gould	Bureau of Reclamation, Lower Colorado Region
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Julie Jackson	Utah Division of Wildlife Resources
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Pat Martinez	Colorado Division of Wildlife
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Steve Meismer	Virgin River Recovery Program
Tim Modde	U.S. Fish and Wildlife Service
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Bob Muth	Upper Colorado River Recovery Program, FWS
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Doug Osmundson	U.S. Fish and Wildlife Service
Steve Petersburg	National Park Service
Frank Pfeifer	U.S. Fish and Wildlife Service
Tom Pitts	Upper Basin Water Users
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J. T. Romatzke	Colorado Division of Wildlife/Colorado State University
Dave Soker	U.S. Fish and Wildlife Service

ACKNOWLEDGMENTS–ATTENDEES (continued)

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Rich Valdez	R.A. Valdez and Associates
Cameron Walford	Colorado State University, Larval Fish Laboratory
Mark Wieringa	Western Area Power Administration
John Wullschleger	National Park Service

ACKNOWLEDGMENTS–PRESENTERS

Thanks are extended to the following individuals for presentations and specific contributions to the respective sections of this report at the Upper Colorado River Endangered Fish Recovery Program's Nonnative Fish Control Workshop held on February 13–14, 2002, in Grand Junction, Colorado. Information provided by these researchers and interactions during the workshop were used as the foundation of this report.

February 13, 2002

Introduction and Moderator . . . . Bob Muth

Statements by Steering Committee Members
State of Colorado . . . . Tom Nesler
State of Utah . . . . Mike Hudson
State of Wyoming . . . . Paul Dey
U.S. Fish and Wildlife Service . . . . Tim Modde

State and Federal Stocking and Harvest Regulations and Issues
State of Colorado . . . . Tom Nesler
State of Utah . . . . Mike Hudson
U.S. Fish and Wildlife Service (American Indian Lands) . . . . Dave Irving
National Park Service . . . . John Wullschleger

Pond Isolation and Rehabilitation
Colorado River Pond Reclamation . . . . Anita Martinez
Green River Wetland Depression Management . . . . Tim Modde

Reservoir Escapement and Prevention Measures
Highline Lake Screening Operation and Management . . . . Pat Martinez

Review/Discussion/Summary of First Day . . . . Bob Muth

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Recap of First Day . . . . Bob Muth

Northern Pike Removal/Translocation
Yampa River (downstream of Craig, Colorado) . . . . John Hawkins
Yampa River Fish Community Population Estimates . . . . Rick Anderson
Upper Yampa River (upstream of Craig, Colorado) . . . . Chuck McAda
Gunnison River . . . . Chuck McAda
Middle Green River . . . . Ron Brunson

ACKNOWLEDGMENTS–PRESENTERS (continued)

Channel Catfish Removal
- Middle and Lower Green River . . . . Mike Hudson
- Lower Yampa River . . . . Tim Modde

Small-Bodied Fish Removal
- Lower Green and Colorado Rivers . . . . Steve Meismer
- Backwaters of the Upper Colorado River . . . . Melissa Trammell

Review/Discussion/Summary of Second Day . . . . Bob Muth

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1.0 INTRODUCTION

1.1 Background

The Upper Colorado River Endangered Fish Recovery Program (UCRRP) considers nonnative fishes as a principal threat to the endangered Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), and bonytail (*Gila elegans*). Over 35 species of nonnative fishes have been identified in the upper basin (Tyus et al. 1982); many are predators, competitors, and vectors of diseases and parasites (Bestgen 1990). A workshop held in 1996 concluded that broad-scale control is not feasible, and specific control strategies that target particular species should be implemented and evaluated (Tyus and Saunders 1996).

1.2 Purpose and Objectives of Workshop

The UCRRP convened a Nonnative Fish Control Workshop on February 13–14, 2002, in Grand Junction, Colorado. The purpose of the workshop was to bring together fish researchers and managers to discuss and evaluate nonnative fish control efforts implemented to date in the Upper Colorado River Basin. Information exchanged at the workshop will be used to modify and refine tasks of the Nonnative and Sport Fish Management element of the UCRRP's Recovery Action Plan (RIPRAP). Tasks of this element are designed to reduce negative impacts of problematic nonnative fishes on the endangered fishes of the upper basin.

The workshop was attended by 45 researchers, managers, and representatives of State and Federal agencies, water users, and energy distributors involved in the UCRRP, as well as representatives of the Bureau of Reclamation, Lower Colorado Region. Presentations were made by individual researchers on each of the tasks identified in the program element on Nonnative and Sport Fish Management. For each task presentation, the workshop objectives were to:

- present what is being done to control nonnative fishes in the upper basin, including results and indices being used to evaluate success;
- identify desirable responses over the short and long term for each problematic nonnative species;
- discuss and evaluate strategies that have or have not achieve desired responses over the short and long term; and
- for strategies that have not achieved desired responses, identify alternatives or modifications that will achieve desired responses.

Following the presentations, a moderator solicited input from the attendees and all information was recorded. A summary of workshop conclusions and recommendations was provided to the Biology Committee and Management Committee of the UCRRP on February 21, 2002.

1.3 Statements of the Steering Committee

An *ad hoc* Steering Committee was established to help develop the workshop format and to provide guidance and direction for nonnative fish control in the upper basin. Steering Committee members were Tom Nesler, Colorado Division of Wildlife; Mike Hudson, Utah Division of Wildlife Resources; Paul Dey, Wyoming Fish and Game Department; and Tim Modde, U.S. Fish and Wildlife Service. Presentations by members of the Steering Committee emphasized a data-driven direction to determine methodologies that are effective or ineffective. This strategy allows the program to focus on the most effective methods and reduce costs and effort through scientific investigation and pilot removal programs. This helps to determine if a "course correction" is needed, and the appropriate direction to take. Past and ongoing investigations indicate that at least some level of nonnative fish control is possible and feasible. It is anticipated that the conclusions and recommendations of this workshop will help with development of action items and tasks of the UCRRP's RIPRAP.

1.4 Organization of this Report

This report was prepared by the Program Director's Office to summarize the information presented and discussed at the workshop, and to document major conclusions and recommendations. A compilation of presentations given at the workshop was provided to workshop participants and serves as a companion to this report; that document is available on request. The report is organized by four major topic areas: (1.0) Introduction, (2.0) Guiding Documents for Nonnative Fish Control, (3.0) Description of Nonnative Fish Control Projects, (4.0) Discussion, Conclusions, and Recommendations, and (5.0) Literature Cited. The principal areas of the report are section 3.0, which provides a description of tasks (i.e., project) as reflected in the UCRRP's RIPRAP and as presented at the workshop; and section 4.0, which provides an overview of workshop discussions, conclusions, and recommendations. Project descriptions provided in section 3.0 were provided by the respective authors (see Acknowledgments), and conclusions and recommendations were gleaned from discussions of workshop participants. Figure format in this report varies and reflects differences in electronic files provided by the presenters.

2.0 GUIDING DOCUMENTS FOR NONNATIVE FISH CONTROL

Six "guiding documents" provide the background and principal guidance for nonnative fish control in the Upper Colorado River Basin. These are the Final Recovery Program Document (U.S. Department of the Interior 1987) of the Recovery Implementation Program for the Endangered Fishes of the Upper Colorado River Basin; the nonnative fish issue paper by Hawkins and Nesler (1991); options for selective control by Lentsch et al. (1996); the strategic control plan of Tyus and Saunders (1996); the nonnative fish stocking procedures (U.S. Fish and Wildlife Service 1996); and recovery goals for the four Colorado River endangered fishes. A description of each of these guiding documents is provided in the following subsections.

2.1 Upper Colorado River Endangered Fish Recovery Program

The final guiding document of the Recovery Implementation Program for Endangered Fishes in the Upper Colorado River Basin (Recovery Implementation Program) was completed on September 29, 1987. The Recovery Implementation Program was initiated under a Cooperative Agreement signed by the Secretary of the Interior in 1988, as a coordinated effort of State and Federal agencies, water users, energy distributors, and environmental groups to recover the four endangered fishes in the upper basin (U.S. Department of the Interior 1987; Wydoski and Hamill 1991; Evans 1993). The Recovery Implementation Program is now known as the Upper Colorado River Endangered Fish Recovery Program (UCRRP). The UCRRP consists of seven program elements, including instream flow protection; habitat restoration; reduction of nonnative fish and sportfish impacts; propagation and genetics management; research, monitoring, and data management; information and education; and program management. Reduction of nonnative fish and sportfish impacts is referred to in the UCRRP's RIPRAP as "Reduce Negative Impacts of Nonnative Fishes and Sportfish Management Activities (Nonnative and Sport Fish Management)".

Tasks that describe projects and activities under each program element are identified in the RIPRAP. Many of the identified tasks are recommendations of the Nonnative Fish Control Strategy (Tyus and Saunders 1996) developed as a result of a workshop held in September 1996. The RIPRAP provides annual guidance on all recovery activities and identifies the nonnative fish control and removal programs and the responsible entity. Twenty-five tasks are currently identified in the RIPRAP under the recovery program element Nonnative and Sport Fish Management. Many of these tasks involve direct removal or translocation of nonnative fishes from the rivers of the upper basin. However, since nonnative fish removal was developed and implemented in the upper basin, there has not been an effective, precise, and reliable way developed to measure success. The amount of effort expended necessary to detect a response has also not been determined.

The current focus of the UCRRP with respect to Nonnative and Sport Fish Management is to:

- confine nonnative stockings to areas where an absence of conflicts with endangered fishes can be demonstrated; this is addressed through development of stocking procedures;
- determine impacts from competition/predation, and if necessary and feasible, remove problematic species from essential areas;
- review sport-fishing practices and regulations, and implement remedial changes, as needed;
- implement an information and education program on nonnative fish control; and
- implement an enforcement program to minimize incidental take of endangered fishes.

2.2 Nonnative Fish Issue Paper

On September 30, 1991, an issue paper by Hawkins and Nesler (1991) consolidated and described for the first time in detail many of the effects of nonnative fishes on the endangered fishes. Problematic species were identified and pertinent research was cited linking particular nonnative fish species to effects from competition and predation. The report provided guidance for study and management of impacts of nonnative fishes through literature review and expert opinion. The report concluded that:

- nonnative fish competition and predation problems occur in most upper basin drainages;
- nonnative fishes of greatest concern include: channel catfish, red shiner, northern pike, common carp, green sunfish, and fathead minnow;
- young Colorado pikeminnow and razorback sucker, as well as young of many native fishes are negatively affected by nonnative fishes, but research is needed to identify mechanisms and management actions to minimize these impacts;
- except for northern pike in the Yampa River and channel catfish in many parts of the upper basin, riverine sport fisheries for other nonnative fishes have small or inconsequential impacts on native fishes;
- incidental take of endangered fishes by angling is not a significant problem; and
- elimination, reduction, or regulation of stocking most common nonnative fishes is proposed.

2.3 Selective Control of Nonnative Fishes

In June 1996, Lentsch et al. (1996) assimilated a report on nonnative fish interactions and potential selective control methods. The report recommended options for controlling problematic nonnative fishes using information on species abundance, distribution, and life-history requirements. Four categories of control methods were identified: (1) chemical, (2) mechanical, (3) biological, and (4) physicochemical. Different control methods were identified as most effective for different groups of fishes. Physicochemical approaches were the most promising option for most cyprinids (minnows) and catostomids (suckers). Mechanical removal was the most promising method for ictalurids, including channel catfish and black bullhead. Control of northern pike was recommended through increased angling pressure, establishment of barriers to prevent escapement from source reservoirs, and netting and electrofishing concentrations of fish in floodplain habitats. Control of centrarchids, especially largemouth bass and green sunfish, was recommended by first reducing escapement from impoundments and then targeting spawning aggregations with mechanical and/or chemical treatments.

2.4 Nonnative Fish Stocking Procedures

Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin (Stocking Procedures; U.S. Fish and Wildlife Service 1996) was developed as a guidance document to ensure that stocking of nonnative fishes in the upper basin was consistent with recovery of the four endangered fishes. A Memorandum of Agreement was signed on September 5, 1996, by the

Service and the States of Colorado, Utah, and Wyoming to review and regulate all stockings within the Upper Colorado River Basin in order to reduce the introduction and expansion of nonnative fishes. This agreement prohibits releases of nonnative fishes within the 50-year flood plain of the river, and remains in effect throughout the life of the UCRRP. The agreement provides security against State or Federally endorsed programs introducing new species into the system or increasing the numbers or distribution of existing species. The agreement also allows the States to regulate and restrict stocking of privately owned ponds. These procedures are also expected to reduce the likelihood of new parasites and diseases being introduced through nonnative fish stockings.

The Stocking Procedures are intended as a way to integrate recreational fishery management with recovery efforts. Four categories of nonnative stockings were identified:

- routine stocking of fishes that currently occur into managed sport fisheries;
- case-by-case stocking of fishes that currently occur, but are not necessarily managed as sport fisheries;
- stocking of new fish species; and
- prohibited stockings.

2.5 Nonnative Fish Control Strategy

A nonnative fish workshop was held in the Upper Colorado River Basin on September 13, 1996. As a result of the workshop, a strategic plan was developed to facilitate recovery of endangered fishes by controlling introductions and proliferation of nonnative, nonsalmonid fishes (Tyus and Saunders 1996). Control was defined as reducing numbers of nonnative fishes to the point where those species no longer are an impediment to recovery. An important aspect of the strategic plan is that the level of reduction should be specified to provide a measure of success. The ultimate aim of the strategic plan is to increase distribution and abundance of endangered fishes.

Three basic themes of control scenarios were identified in the strategic plan:

1. Prevent nonnatives from entering the system by:
    a. Installing escapement controls on some major reservoirs or other sources areas; problematic species were identified as common carp, northern pike, smallmouth bass, and black crappie.
    b. Applying chemical treatments to ponds in floodplains.
2. Remove nonnative fishes from the main river channel by:
    a. Applying mechanical techniques (e.g., trapping, electrofishing, increased recreational angling or implement commercial harvest).
    b. Flow management has the potential for reducing centrarchids and small cyprinids, but cause-effect relationships need to be evaluated.
3. Exclude nonnative fishes from interactions with larvae and juveniles of native fishes by:
    a. Active management of inundation cycles for backwaters and floodplain habitats.
    b. Install barriers, weirs, etc. in high-priority areas.

The strategic plan identified a two-tiered approach:

1. Basin-wide Level.—This tier prevents introductions of nonnatives, reduces abundance of nonnatives in main channel habitats, and mitigates losses of sport-fishing opportunities.
2. River-reach Level.—Three high-priority reaches were identified:
    a. Yampa River from Deerlodge Park to confluence with the Green River,
    b. Green River from Yampa River confluence to Desolation Canyon, and
    c. Colorado River from Government Highline diversion to Cataract Canyon.

2.6 Recovery Goals for the Four Endangered Fish Species

On September 10, 2001, the U.S. Fish and Wildlife Service (Service) released draft recovery goals for the four Colorado River endangered fishes for public review through a Notice of Availability in the Federal Register (66 FR 47033–47034). These recovery goals provide site-specific management actions and objective, measurable criteria for downlisting and delisting the endangered Colorado pikeminnow, humpback chub, razorback sucker, and bonytail. Control of nonnative fishes is identified as a site-specific management action in each of the four recovery goals documents. [Note: Final recovery goals were signed by the Service on August 1, 2002, and the notice of their availability was published in the *Federal Register* on August 28 (67 FR 55270–55271)].

Five basic aspects of nonnative fish control are identified in the recovery goals with specified criteria for downlisting and delisting:

1. Nonnative Fish Stocking Procedures (all four species)
    a. Downlisting.—Procedures developed, implemented, evaluated and revised.
    b. Delisting.—Procedures finalized and implemented.
2. Channel Catfish Control Programs (for humpback chub)
    a. Downlisting.—Programs developed and implemented to identify necessary levels of control in Yampa Canyon, Desolation/Gray Canyons.
    b. Delisting.—Identified levels of control attained.
3. Control Programs for Small-bodied Nonnatives (for Colorado pikeminnow, razorback sucker, bonytail)
    a. Downlisting.—Programs in nursery habitats/occupied reaches developed and implemented to identify necessary levels of control.
    b. Delisting.—Identified levels of control attained.
4. Channel Catfish Control Programs (for Colorado pikeminnow, razorback sucker, bonytail)
    a. Downlisting.—Programs in occupied reaches developed and implemented to identify necessary levels of control.
    b. Delisting.—Identified levels of control attained.

5. Northern Pike Control Programs (for Colorado pikeminnow, razorback sucker, bonytail)
   a. Downlisting.—Programs in occupied reaches of the Yampa and middle Green rivers developed and implemented to identify necessary levels of control.
   b. Delisting.—Identified levels of control attained.

3.0 DESCRIPTION OF NONNATIVE FISH CONTROL PROJECTS

3.1 Public Information and Education

Public information and education (I&E) is an essential element of the UCRRP. This is especially important considering the great deal of misinformation and misunderstanding that has historically surrounded the Colorado River endangered fishes. The I&E program has been very effective at informing the public about the need and strategies for conserving the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. Control of nonnative fishes brings new challenges for the I&E program, because some of the species in need of control are considered valuable sport fish by the angling public. The vast majority of valued sport fisheries do not conflict with the conservation of the Colorado River endangered fishes. Nevertheless, the public sometimes views control efforts in specific areas of the upper basin as a potential threat to sport fishes elsewhere. One challenge of the I&E program is to place nonnative fish control into perspective with respect to sport fisheries throughout the upper basin.

The nonnative fish control element of the UCRRP is currently in its developmental phases and as such, is a relatively new program that needs to be described and explained to the public. It is especially important to relate to the public that most nonnative fish control programs are not in conflict with sport fishing programs, and many are coordinated to enhance sport fishing. For example, control of northern pike in the Yampa River is being accomplished through translocation of live fish from the river to nearby ponds where anglers can catch these fish. It is also important to inform the public of the general harm that too many nonnative fishes can have on an ecosystem, including valued sport fisheries.

3.2 State and Federal Stocking and Harvest Regulations

In 1996, the UCRRP was instrumental in development of the Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin (Stocking Procedures; U.S. Fish and Wildlife Service 1996). This document affected not only fish stocking policies, but harvest regulations of the upper basin States (see section 2.4). The following are overviews of effects of the Stocking Procedures on the States of Colorado and Utah, as well as the U.S. Fish and Wildlife Service's Wildlife Management Assistance Program, and the National Park Service.

3.2.1 State of Colorado

The State of Colorado supports the Stocking Procedures and is a signatory to the agreement in support of these procedures. Stocking of warmwater fish in westslope waters by the Colorado Division of Wildlife (CDOW) was suspended until management plans for existing fisheries were reviewed and approved through the Procedures protocol. The State finds that there is a need to demonstrate the need and benefits of regulations for nonnative fish stocking and harvest to the public. The public perceives stocking and harvest regulations as potential infringements on fishing privileges and opportunities. This perception is particularly embraced by landowners with private waters and the aquaculture industry that markets gamefish to the public. The current Stocking procedures are complex and difficult to interpret, and will need to be re-evaluated soon. The CDOW would like to simplify the Stocking Procedures so that it is easier for the State to formulate and enforce regulations, and administer a permitting program. Development of regulations to control fish stocking in private waters, and the associated permit system to oversee such stocking, has been difficult to set up and difficult for permitees to understand due to the complexities of the Procedures.

An effective program to control stocking of nonnative fishes will need to clearly define the impact of nonnative fish to the public before moving ahead with extensive controls. It would be necessary to garner support from the angler public before enacting such regulations as requiring anglers to kill and keep all fish captured of certain species. These kinds of regulations can have varied effects on anglers. Some anglers may perceive a given regulation as a precursor to more stringent actions that may further limit fishing opportunities, or as a statement on the quality of the resource. For example, Colorado anglers have indicated voluntary catch and release protocol will be promoted to counter state regulations removing bag and possession limits on their preferred gamefish species. Use of bag limits to remove nonnative species is effective only if angler attitudes and reactions are well understood. With reduced stocking of warmwater gamefish species in westslope waters, illicit introductions of fish into public fisheries appears to be on the rise.

3.2.2 State of Utah

All proposed stocking actions in the State of Utah are consistent with the Stocking Procedures. Utah also tracks all stocking information (public and private waters) from throughout the Colorado River Basin and reports this information annually to the U.S. Fish and Wildlife Service as per section X of the Stocking Procedures. Utah's current stocking policy for nonnative, nonsalmonid fish species in the Upper Colorado River Basin is consistent with endangered fish recovery and interagency agreements of which the State of Utah is a signatory.

Nonnative fish stocking policy in Utah has changed because of agreements, such as the Stocking Procedures. Tiger muskie are currently the only nonnative, nonsalmonids species which may pose a threat to the endangered fishes that is currently stocked in upper basin Utah waters by the Utah Division of Wildlife Resources (UDWR). UDWR stocked tiger muskie in Johnson Reservoir (Fremont River drainage) in 1999. This stocking was approved by the signatories of the Stocking Procedures as an exception to the general rules with the stipulation that UDWR must monitor for downstream escapement. Monitoring at three locations (Mill Meadow Reservoir, Fremont River, and Lake Powell) with electrofishing and gill nets has documented no downstream escapement of tiger muskie from Johnson Reservoir. UDWR fish stocking and transfer procedures explicitly state that northern pike are not to be stocked in Utah.

Private pond owners may also stock nonnative fishes provided they apply for proper permits, their ponds meet minimum requirements, the species are not prohibited in Utah, and their stocking plans are consistent with interagency agreements. Most private ponds in the basin approved for stocking of nonnative species have been stocked with salmonids. A much smaller number of private ponds have been approved for other nonnative species, which include mainly bluegill, largemouth bass, and/or triploid grass carp.

Although nonnative fish policy has changed in Utah to reflect an interagency effort to recover the endangered fishes of the Upper Colorado River Basin, some waters have naturally reproducing populations of nonnative fishes. These naturally reproducing populations are a result of stocking practices that have been discontinued, and Utah recognizes that escapement of nonnative fishes from these locations may impact downstream populations of native fishes. Starvation Reservoir is an example of a Utah water that will soon undergo evaluation for nonnative fish escapement, particularly walleye and smallmouth bass. Walleye and smallmouth bass were last stocked in Starvation Reservoir in 1980 and 1982, respectively.

Harvest limits for nonnative, nonsalmonid fish species in the Colorado and Green rivers have been increased by Utah in an effort to support nonnative species control and reduce impacts of nonnative fishes on the endangered species (Table 1). These regulations have affected especially channel catfish, bullheads, northern pike, smallmouth bass, and walleye.

The Stocking Procedures form the basis for many of Utah's current stocking policies. Appendix A of the UDWR Fish Stocking and Transfer Procedures (effective September 24, 1997) states that:

> *"Stocking of nonnative fish species will be consistent with the Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin – Upper Colorado River Basin above Glen Canyon Dam (does not include San Juan sub-basin)."*

This policy applies to all stocking of nonnative, nonsalmonid species in both private and public waters within the basin. Private pond owners wishing to stock nonnative species must apply for a private fish pond Certificate of Registration (COR). Two minimum requirements of private ponds must be met before a COR application will be considered:

- private ponds cannot be constructed on natural flowing streams; and
- private pond inflows (except springs) and outflows must be screened.

Preliminary pond inspections are performed by UDWR personnel and ponds that do not meet these minimum requirements will not be considered for COR approval. After the UDWR determines that the minimum requirements have been met and the proposal is consistent with conservation and interagency agreements (includes Stocking Procedures), the proposed species to

Table 1. General harvest regulations in Utah, from the 2002 Proclamation.

Fish Species	Statewide	Green and Colorado Rivers	Starvation Reservoir
Bullheads	24	24	24
Channel catfish	8	24	8
Northern pike	6	12	6
Smallmouth bass	6	6	6
Walleye	6	6	10 (only one >20")

be stocked must be among those that have been approved by the Utah Wildlife Board and UDWR for importation, transportation, and possession in Utah. Typically, requirements for CORs and pond inspections allow enforcement of this regulations on people trying to comply. There are many unknown nonnative fish stockings in ponds that do not comply with UDWR pond registration regulations.

Proposals to stock nonnative fish species in Utah are not implemented until they have undergone a critical interagency review and approval process. Fish species to be stocked in basin waters of Utah must be from a source that has been inspected by and received a certified health approval number. Health certification is intended to prevent the spread of disease-causing pathogens. Health certificates are obtained from either:

- UDWR (for private ponds within the State, public aquaculture facilities, and public waters); or
- Utah Department of Agriculture and Food (for aquaculture and fee fishing facilities).

The process for stocking public waters with nonnative, nonsalmonid fish species in Utah involves the following:

- UDWR develops a proposal to stock a water body within the basin and the proposal is consistent with conservation and interagency agreements (including Stocking Procedures);
- proposal is submitted for interagency review and comment; and
- provided Federal action is not required and the interagency review reaches consensus, the stocking action may be implemented.

3.2.3 U.S. Fish and Wildlife Service (American Indian Lands)

The Utah Fish and Wildlife Management Assistance Office of the U.S. Fish and Wildlife Service provides technical assistance to the Northern Ute Indian Tribe (Tribe) to help them manage their fish and wildlife resources. The Tribe is located on the Uintah and Ouray Indian Reservation in northeastern Utah. The reservation consists of about 1.2 million acres and is the second largest reservation in the United States. The Service and the Tribe have developed a Fisheries Management Plan to provide objectives and guidelines for the management of Tribal fishery resources. Portions of the Green, White, and Duchesne rivers are found on the Reservation. These rivers contain populations and critical habitat of the endangered Colorado pikeminnow, razorback sucker, humpback chub, and bonytail.

On average about 30,000 rainbow, cutthroat, brown, and brook trout are stocked on the Reservation each year. About 24,000 angler hours are spent fishing on the Reservation each year and these anglers catch around 10,000 fish (catch per unit effort [CPUE] = 2.4 fish/hour). Most of the anglers are Non-Tribal members who are required to purchase a Tribal fishing license. For the most part, Tribal fishing regulations are the same as State regulations. The only difference is that the Tribe allows a daily possession limit of eight fish instead of four.

Fish stocked on the Ute Indian Reservation are produced at Jones Hole National Fish Hatchery. The hatchery was authorized in 1956 to mitigate losses to fish and wildlife in Utah, Colorado, and Wyoming as a result of the Colorado River Storage Project. The hatchery is mandated to provide about two million trout for various lakes, reservoirs, and rivers throughout the areas. It is calculated that this will provide about 0.6 million angler days/year.

The Service provides assistance to the Ute Indian Tribe as part of the Federal government's Trust Responsibilities to Indian tribes resulting from treaties, statutes, executive orders, and judicial decisions. This trust responsibility requires the Service to help manage natural resources held in trust for Indian tribes, acknowledge treaty obligations and tribal rights, and recognize Tribal governments as separate sovereign nations.

Indian lands are not Federal or public lands and are not subject to Federal or State laws. These lands were set aside pursuant to treaties, statutes, judicial decisions, executive orders or agreements. Indian tribes manage them according to their own goals within the framework of applicable laws.

Although Indian tribes acknowledge the Endangered Species Act, they expect recognition of their sovereignty and tribal rights. This has lead to legal disagreements. The Federal government and Indian tribes have agreed to set these differences aside and work together to maintain and restore healthy ecosystems and promote species conservation.

The Ute Indian Tribe was invited by the Service and the States of Colorado, Utah, and Wyoming to participate in the development of the Stocking Procedures. The Tribe declined to participate because they did not want others dictating how they manage their recreational fishing. The Tribe has issued a written statement to the Service indicating that they would inform the Service and the States about any future nonnative fish stocking on the Reservation. It is the belief of the Ute Indian Tribe that they are effectively in compliance with the Stocking Procedures.

3.2.4 National Park Service

The approach of the National Park Service (NPS) to management of nonnative species is founded in Congressional legislation pertaining to both the park system as a whole and to individual parks. While the enabling legislation for individual park units may contain special provisions, the Organic Act, General Authorities Act, and Redwoods National Park Act require NPS to conserve and protect park resources systemwide, while providing for the enjoyment of those resources by the people of the United States. Where resource protection and public enjoyment purposes have been in conflict, courts have consistently determined that resource protection is the "primary goal" of the park service.

Although NPS has some discretion in allowing impacts to park resources to provide for enjoyment by the public, it is prohibited from engaging in actions or allowing activities that result in impairment. Impairment is generally defined as any impact that would harm the integrity of park resources or values, including opportunities that would otherwise be present for the enjoyment of those values or resources. These legislative mandates are implemented through regulations and NPS management policies. Black Canyon of the Gunnison National Park, Currecanti National Recreation Area, Dinosaur National Monument, Canyonlands National Park, and Glen Canyon National Recreation Area do not have park-specific regulations pertaining to the introduction and management of nonnative species. Service-wide regulations that may have some bearing on the management of nonnative aquatic species include 36 CFR Ch. 1 paragraph 1.5, which gives park superintendents the authority to regulate or prohibit activities that affect park resources and, more specifically, 36 CFR Ch. 1 paragraph 2.3, which prohibits the use of live bait by anglers. NPS resource management policies prohibit the introduction of nonnative species except for specific well-defined park purposes and where all feasible and prudent measures have been taken to reduce the risk of harm to park resources and resource values. Management policies call for the control and/or eradication of nonnative species that are not managed for identified park purposes, where those species have existing or potential impacts on native species or other park resources.

National Park Service Management Policies of 2001 provide specific policies with regard to harvest of plants and animals by the public, management of exotic species, introduction or maintenance of exotic species, and removal of exotic species already present. Harvest of plants and animals by the public is allowed for hunting, trapping, subsistence use, or other harvesting specifically authorized by statute or regulation. Recreational fishing if not specifically prohibited and commercial fishing is specifically authorized by statute or regulation. Stocking of fish into constructed large reservoirs or other significantly altered large water bodies is allowed to provide recreational fishing. The Park Service may stock native or exotic animals for recreational harvest purposes, but only when such stockings will not impair park natural resources or processes. The Park Service will not stock waters that are naturally barren of harvested aquatic species.

Management of exotic species regulates that exotic species will not be allowed to displace native species if displacement can be prevented. In general, new exotic species will not be introduced into parks unless introduction meets specific identified management needs when all feasible and prudent measures to minimize the risk of harm have been taken. Introduction or maintenance of exotic species also provides that exotic species are managed within national parks so that they will not spread or become pests on parks or adjacent lands. Exotic species are also managed so that available native species meet park management objectives.

Removal of exotic species already present is also an important aspect of Park Service management policies. All exotic plant and animals species that are not maintained to meet an identified park purpose will be managed, including eradication if control is prudent and feasible, and the exotic species interferes with natural processes and perpetuation of natural features. The Park Service places low priority on exotic species that have almost no impact on park resources or that probably cannot be successfully controlled.

3.3 Pond Isolation and Rehabilitation

3.3.1 Colorado River Pond Reclamation (Project No. CAP-18/19; Colorado Division of Wildlife [CDOW])

An inventory of riverside ponds along the Colorado River between Rifle and Loma, Colorado, and the Gunnison River between Austin, Colorado, and the confluence of the Colorado River was conducted from 1997 through 2001. The objectives of the project were to:

- negotiate access to private, public, and municipal ponds along the Colorado River downstream of Rifle and along the Gunnison River downstream of Austin;
- ensure cooperative lasting working relationships with landowners;
- remove unwanted nonnative fishes from riverside ponds via chemical treatment, water management, black plastic liners, or other techniques;
- install inlet/outlet screens to control movement of nonnative fish from riverside ponds into critical habitat; and
- contribute to I&E efforts with interested PAI's when possible.

This inventory identified 744 ponds, similar to those reported by Mitchell (1995). Of these, 355 ponds were investigated, of which 198 supported fish, 39 were void of fish, 21 were taken over by the river since the Mitchell (1995) report, 60 were ephemeral, and 17 were mistakenly identified as ponds by Mitchell (1995). A total of 237 private, public, and municipal ponds (total of 737 surface acres) were sampled. A total of 15,316 fish (14,945 nonnative fish; 371 native fish) were collected in 198 ponds that supported fish (Figure 1). Nonnative non-sport, nonnative sport, and native fish comprised 84% (12,783), 14% (2,162), and 2% (371) of the total number of fish sampled, respectively. Green sunfish (33%) was the most common fish species collected followed by fathead minnow (18%) and black bullhead (11%). Of the 24 fish species captured, totaling 15,316 fish, flannelmouth sucker, roundtail chub, and bluehead sucker comprised 1.3% (193), 1.0% (146), and 0.2% (32) of the total number of fish, respectively. No threatened or endangered fish were collected.

Treatments to control nonnative fish were applied to 75 ponds and included piscicides, water management, and black plastic pond liners. A total of 3,024,000 fish were chemically removed, including 500 native fish (<0.02%), 61,000 nonnative sport fish (2%), and 2,962,500 nonnative

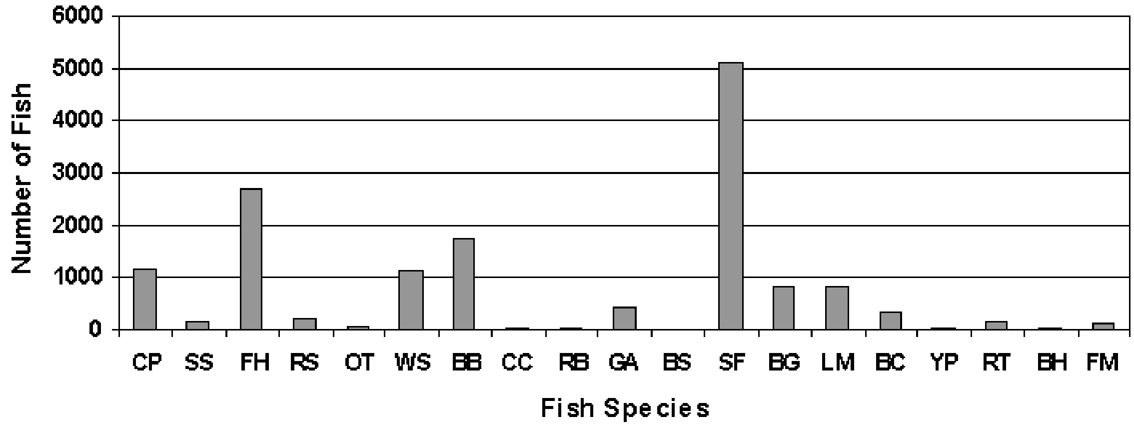


Figure 1. Fish sampled in 198 ponds along the Upper Colorado River (1997–2001); N = 15,316; native fish = 371; nonnative fish = 14,945.

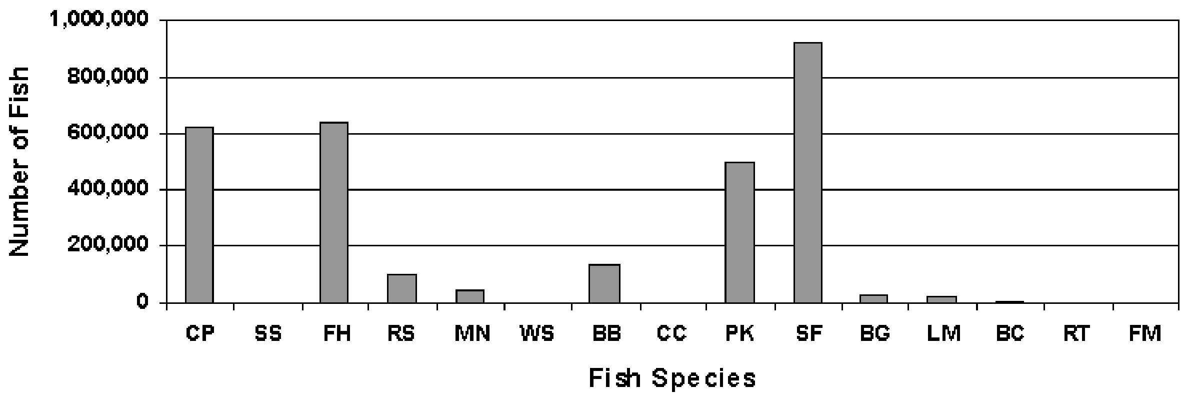


Figure 2. Fish removed from 73 chemically reclaimed ponds along the Upper Colorado River (1997–2001); N = 3,024,000; native fish = 500; nonnative fish = 3,023,500.

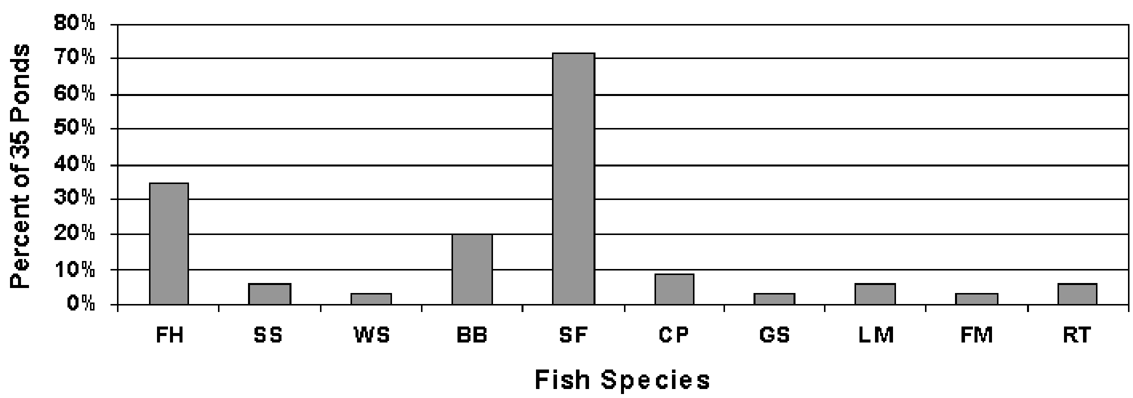


Figure 3. Percent reinvasion of fish species into 35 reclaimed ponds along the Upper Colorado River.

non-sport fish (98%) (Figure 2). Of these 75 ponds, 54 were sampled one to four years following treatment. Follow-up inspection and fish sampling showed that 35 (65%) of these 54 ponds had been reinvaded by nonnative fish, six (11%) were dry, and 13 (24%) had not been reinvaded by the date sampled. Twelve ponds (34%) were reinvaded by fathead minnow and 25 (71%) were reinvaded by stunted green sunfish (Figure 3). Most ponds that reinvaded fill with irrigation water or water pumped directly from the rivers. Though seasonal filling and drying of ponds/wetlands controlled resident nonnative fish, they were easily reinvaded by nonnative fish from neighboring ponds or through irrigation water.

Additional effort to control invasion or escapement by nonnative fish was attempted by the installation of nine outlet and two inlet screens that functionally treated 27 ponds. Though none of the outlet screens have been evaluated, larvae of fathead minnow, roundtail chub, and red shiner passed through a 0.5-mm wedgewire screen installed on the intake to the threatened and endangered fish ponds at Horsethief Canyon State Wildlife Area.

An incentive package was developed to provide a monetary incentive to encourage voluntary participation in the Nonnative Fish Control Program. Door-to-door discussions and negotiations were held with landowners which fostered cooperation and facilitated access to privately owned land. In the sampling phase, contracts were signed with each landowner, and they were paid $100 per surface acre after sampling. As part of the contract, fish were removed at landowner discretion. A total of 45 landowners participated from 1997 to 2001. Screening of outlets on jurisdictional dams required a 10-year commitment by the landowner for maintenance and operation and a three-way contract between the landowner, vendor, and CDOW; screens at other sites or non-jurisdictional dams did not have these requirements. Eight landowners participated in screen installation from 1997 to 2001. Ponds were screened through a process of negotiation with land owners that included landowner input on design and installation. Experimental screens were strategically installed on two inlet and nine outlet. These screens may control the movement of nonnative fish in 27 ponds (140 surface acres). Evaluation of both inlet screens is ongoing. Screening concerns include maintenance and design, dam safety, berm height, and water velocity and pressure (head).

Methods of controlling nonnative fishes included chemical treatment with rotenone (power & liquid) and chlorine; water management; black plastic liners; and herbicides. Rotenone was applied by boat or from the shore. Boat application included dripping rotenone into the water or it was educted (vacuumed) through pumps and sprayed onto pond surfaces and mixed with the action of the boat propeller. For shore application, rotenone was educted through a pump from an agricultural tank and sprayed onto the pond surface. A total of 75 ponds (352 surface acres) within the study area were treated with one or more of these methods. A non-toxic dye was applied to identify leaks or underwater pipes prior to reclamations.

Sampling workshops and Information and Education programs were provided to Project Wild teachers, and Mesa College and Grand Valley public school (grades 3 through 12) students.

The study recommended the following:

1. determine if nonnative fish control activities reduce the numbers of nonnative fish entering the rivers possibly through the use of stable isotopes or GIS;
2. evaluate the effectiveness of inlet/outlet screens in controlling the movement of nonnative fish out of riverside ponds;
3. investigate the possible impact of recently developed wetlands as chronic sources of nonnative fish entering the Colorado and Gunnison rivers;
4. encourage additional enforcement of the nonnative fish stocking regulation in Colorado;
5. determine the impact of stocking nonnative fish above 6,500 feet elevation on the abundance of nonnative fish in the Colorado River below Rifle and in the Gunnison River below Austin and consider a reporting requirement for fish stocked above 6,500 feet in these drainages;
6. conduct a literature review of potential/optimal screen designs with consideration of the current nonnative fish composition in both ponds and rivers, site constraints, fouling/maintenance impacts, dam safety and cost; and
7. examine the potential of installing a series of horizontal flat plate screens in the bottom of large irrigation drainage ditches to remove juvenile/adult nonnative fish from return flows to the Colorado River.

3.3.2 Evaluation of Nonnative Stocking Regulations (Project No. 106; CDOW)

The State of Colorado is currently evaluating State stocking regulations and policy in light of the Stocking Procedures developed by the UCRRP in 1996 (see section 2.4). State regulations currently require screening outflows and in some cases inflows/inlets of individual ponds, below 6,500 feet elevation within the Upper Colorado River Basin, to minimize escapement of nonnative fishes from stocked ponds into occupied and critical habitat of the four endangered fishes. Data from stocking permits, private aquaculture records and baseline inventory are being used in a GIS-based analysis to examine links between stocking of off-channel ponds and the presence/abundance of the same species in the mainstem Colorado River. This analysis will provide background for a risk assessment for stocking nonnative fish species. Efforts such as described in section 3.2.1 of this document illustrate the difficulty of enforcing a stocking regulation broadly to all ponds and the complexity of overseeing and enforcing required screen placements.

3.3.3 Operation and Management of Large Wetland Depressions on the Ouray National Wildlife Refuge (Project No. CAP-6 OCW; USFWS-Vernal)

The Recovery Implementation Program for the Endangered Fishes in the Upper Colorado River Basin (Recovery Program) began investigating off-channel wetlands as habitat for endangered fishes between 1994 and 1996 at Old Charlie Wash on the Ouray National Wildlife Refuge. Old Charlie Wash is a natural depression in which natural levees were expanded and a water drain was added. Following the 1994 field season, the water control structure of the wetland was rebuilt to improve draining and a second water control structure and concrete footings were added to permit a census of fish in the impoundment. During the initial studies between 1994 and 1996 the principal objectives were to determine the presence of razorback sucker in the wetland. However, large numbers of nonnative fishes were collected during the draining process and the Recovery Program continued to monitor Old Charlie Wash for several years for the purposes of determining the occurrence of razorback sucker and to remove nonnative fishes. The drainage ditch in Old Charlie Wash began to fill with sediment and prevented complete draining and census of the fish population in 1997 through 1999, after which the drain was cleaned. Census data were provided during 1995, 1996 and 2001.

During 1995 and 1996, nonnative fish in Old Charlie Wash made up over 99.9% of the biomass collected during both years, of which a minimum of 80% and 77%, respectively, originated from the Green River prior to floodplain connection (Figure 4). These percentages do not include the biomass of small cyprinids that were collected in the wetland (5% in 1995 and 4% in 1966) which could not be segregated, but many surely originated from the river. Thus, most of the nonnative biomass collected from Old Charlie Wash originated from the river. Because most fish originated in the river, the biomass of fish present in the wetland was variable, ranging between 32.4 kg/ha to 126 kg/ha. Although greatest numbers of fish were <age-0, greatest biomass was made up of >age-0 (Figure 5). Carp, fathead minnow, and green sunfish consistently accounted for the greatest numbers and biomass of fish in Old Charlie Wash (Table 2). Numbers of juvenile carp in backwaters were higher in some years (e.g., 1986, 1989), indicating strong year classes, and numbers after draining Old Charlie Wash did not change substantially in Green River backwaters (Figure 6). Average weights of carp in 1994 and 1995 were 597 and 490 g; channel catfish were 131 and 262 g, and black bullhead were 91 and 96 g, respectively.

The biomass of fish captured and removed from the wetland appeared to be related to the duration of inundation (Figure 7). That is, the longer the wetland was connected to the river, the greater number of fish present in the wetland. The relationship of total biomass of fish originating from the river and discharge duration is probably different for Old Charlie Wash and wetlands that maintain water through the winter which allows the development of refuge populations. Using water control structures that have been constructed, sites such as Old Charlie Wash and Johnson Bottom have the potential to remove a larger biomass of nonnative fish than is practical with other removal methodologies. However, the questions remaining are: 1) are the species that readily move into wetland depressions (i.e., carp, fathead minnow and to a lesser extent channel catfish) species of concern relative to impacts on listed fishes, and 2) even though large numbers of fish are removed, can enough fish be removed to make a difference on the existing riverine population?

The study concluded:

- most fish biomass collected in wetlands drained the previous year consisted of fish that entered from the river (i.e., adults and subadults);
- the number and biomass of fish captured in OCW was positively correlated with the duration of inundation;
- cost of operation to remove fish low;

- most fish that access floodplain depressions are lentic oriented species, i.e., carp, fathead minnow, green sunfish and black bullhead. The exception being many larger channel catfish; and
- either removal from wetland depressions have had little impact on recruitment of nonnative fish, or insufficient effort has been expended to detect a difference.

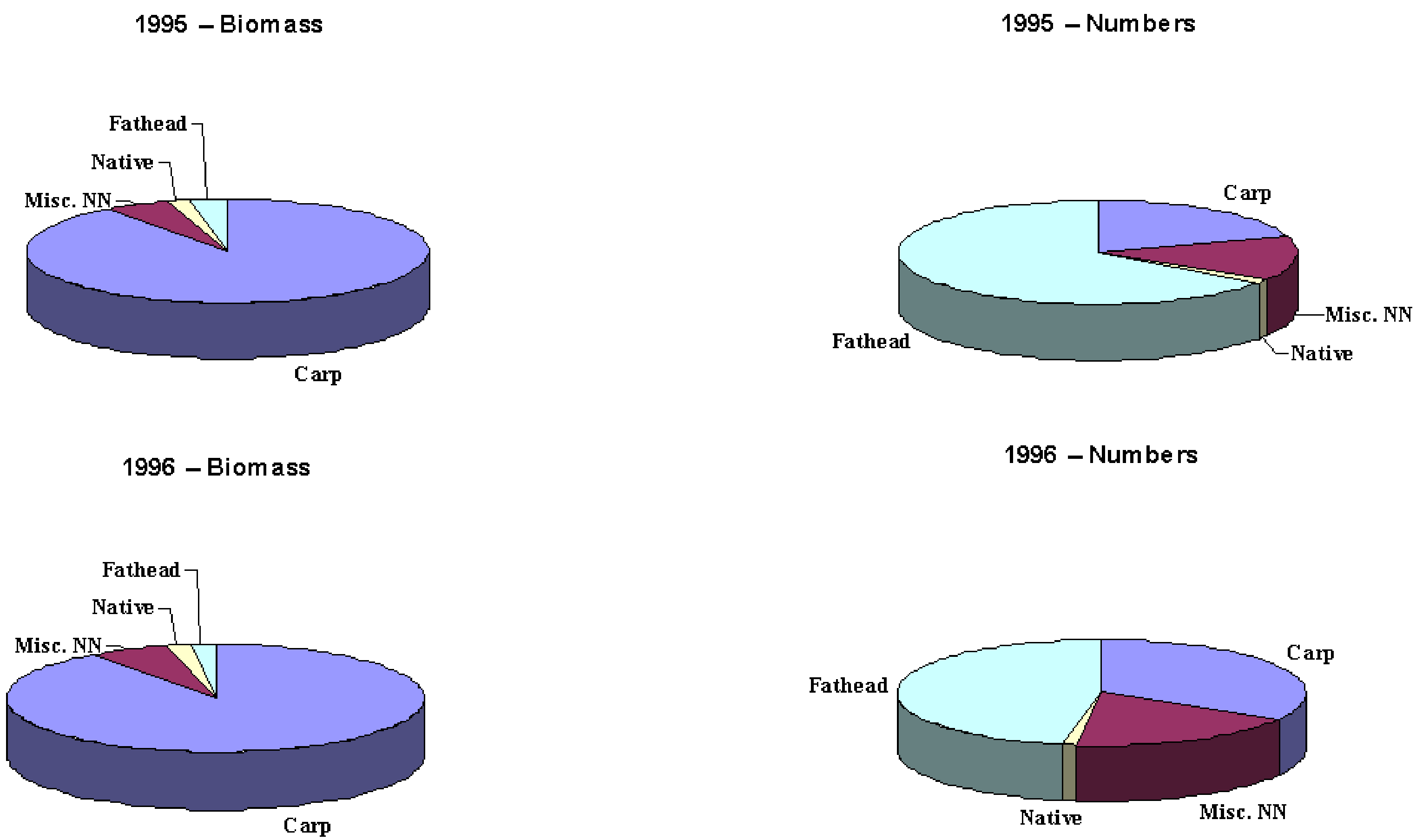


Figure 4. Percent biomass and numbers of fish collected when draining Old Charlie Wash in 1995 and 1996.

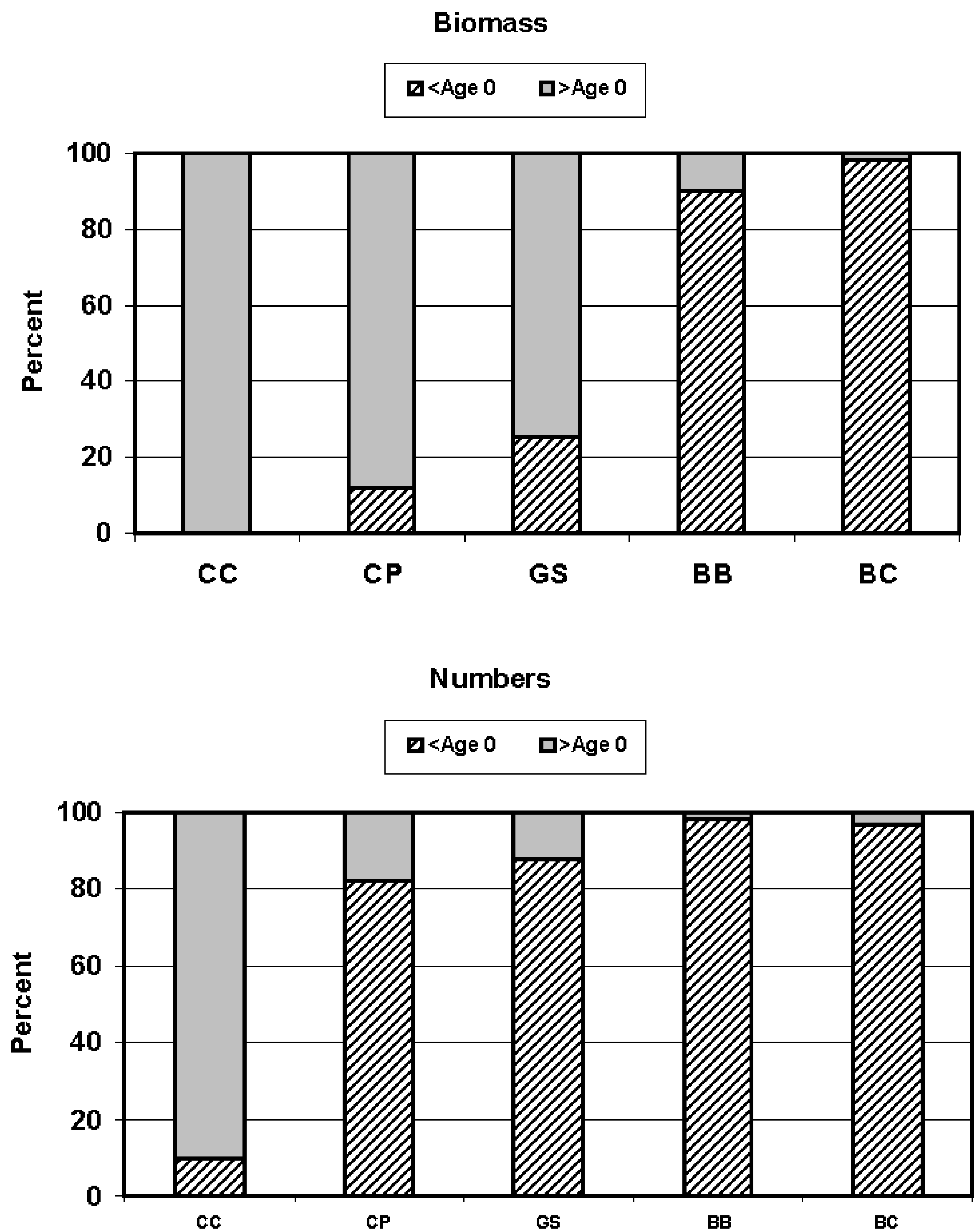


Figure 5. Biomass and numbers of adult and juvenile fish collected from Old Charlie Wash in 1995.

Table 2. Biomass rankings of fish collected from draining Old Charlie Wash in 1995 and 1996.

Fish Species	Biomass Ranking	
	1995	1996
common carp	1	1
fathead minnow	2	2
green sunfish	3	3
channel catfish	4	5
black bullhead	5	6
red shiner	6	7
black crappie	7	4
northern pike	---	9
Utah chub	10	11
white sucker	11	12
brook stickleback	14	13
razorback sucker	8	9
flannelmouth sucker	11	8
Colorado pikeminnow	12	10
roundtail chub	13	13

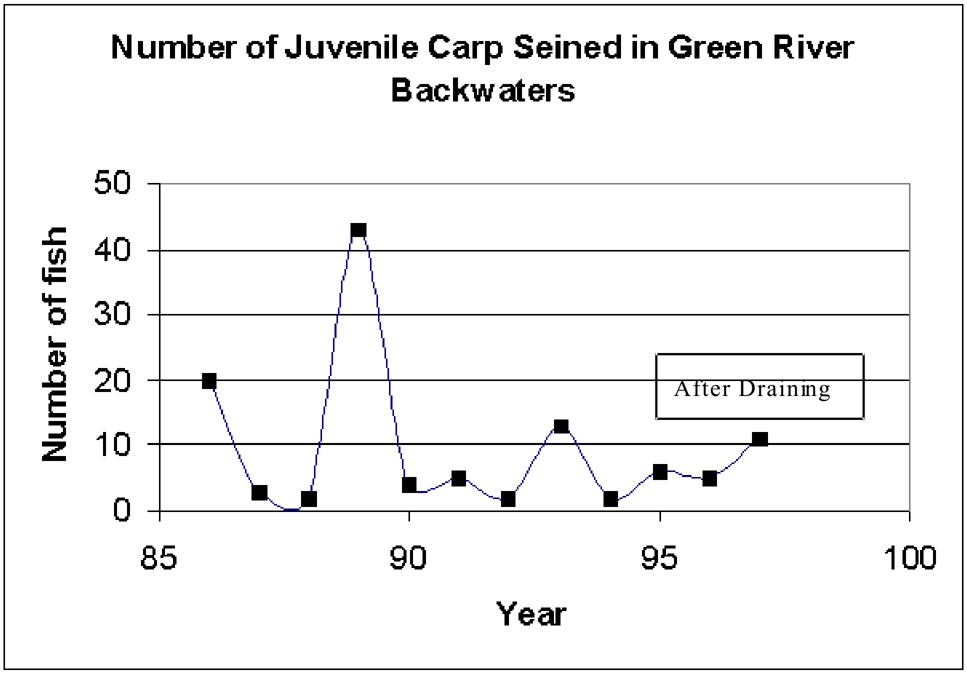


Figure 6. Number of juvenile carp seined in Green River backwaters, 1986–97; numbers recorded in 1995–97 were after draining of Old Charlie Wash.

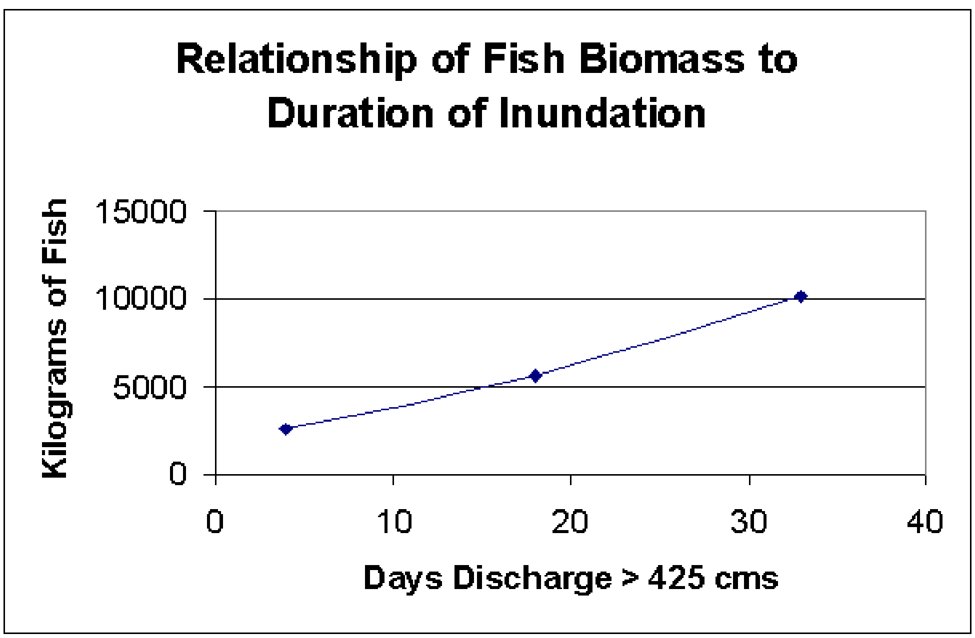


Figure 7. Relationship of fish biomass to duration of inundation of Old Charlie Wash in the Middle Green River, Utah, 1994–95.

3.4 Reservoir Escapement Prevention Measures

3.4.1 Highline Screening Operation and Management (Project No. CAP-20; CDOW)

Escape of nonnative fish from Highline Lake into critical habitat of the endangered Colorado pikeminnow, razorback sucker, humpback chub, and bonytail in the Colorado River has been an ongoing concern. Highline Lake is located about 15 miles northwest of Grand Junction, Colorado; the lake drains into Mack Wash and then into Salt Creek into the Colorado River, about 6 stream miles from the lake. In the year 1999, a program was initiated by the Colorado Division of Wildlife, through the Upper Colorado River Endangered Fish Recovery Program (UCRRP) to screen the outlet from Highline Lake and minimize escapement of nonnative fishes.

The screen installed at Highline Lake was a 363-foot wide x 19-foot deep x 0.25-inch aperture spillway barrier net fabricated of Dyneema (dry weight = 1,400 pounds). The screen was installed in Highline Lake in August 1999 to control escapement of juvenile and adult nonnative fish. Highline Lake covers 160 surface acres, has a maximum depth of 50 feet, and is at 4700 feet elevation. The UCRRP provided $384,000 in funding, including costs for the net ($95,000); evaluating net options, feasibility analyses, and engineering ($87,000); coordination and administration ($42,000); and installation ($160,000) (Table 3). Evaluation of the net's performance and effectiveness in controlling fish escapement in 1999–2001 was $65,000. The estimated serviceable net life was projected to be 3–5 years under local climatic conditions.

Monitoring of the net's performance included observations on:

- the seal between the net's bottom skirt and the lake bottom;
- sand and gravel being wave-washed onto the net nearshore; and
- the net's main float line submerging during a period of high flow through the reservoir.

Aspects of the net's maintenance included:

- estimated vs. actual expenditures for inspections and cleaning in 2000 and 2001;
- leaving the net in place over winter vs. removing it; and
- correcting the tendency for the net's top skirt to sag and adjoin the net's main float line.

Initially, annual maintenance costs for the net were projected to be about $15,000. Actual costs to maintain the net totaled $12,000 in 2000 and $5,650 in 2001. The lower cost in 2001 was because the net was cleaned by personnel from Colorado Division of Parks and Outdoor Recreation (State Parks administers recreational activities on Highline Lake) instead of by hired divers.

The net is fabricated of Dyneema and is claimed to last longer than nylon. Dyneema has the highest specific strength and modulus among commercial organic fibers. The specific gravity of Dyneema, 0.97, is the lowest among super fibers and is lighter than water. Medium to heavy growth of medium moss accumulated on the net during operation in 2000, resulting in "heavy

Table 3. Cost of Dyneema net evaluation, installation, and purchase, as a fish barrier on Highline Lake.

Action	Cost
Evaluate net options, feasibility analyses, and engineering – AYRES	$87,000
Coordination and administration – CRWCD	$42,000
Dyneema net – Redden Nets	$95,000
Installation – Ashley Construction	$160,000
Funding for fish barrier net – UCRRP	$384,000
Evaluation of net performance and effectiveness in controlling fish escapement (1999–2001) – CDOW	$65,000

saturation". In conjunction with heavy wind and wave conditions, the main body of the net experienced a "maximum drag". The net was cleaned by State Parks in 2001 by raising portions above the water and washing with a high-pressure spray.

Fish sampling and marking was performed in Highline Lake to evaluate fish escapement from the reservoir and downstream movement of nonnative fish toward the Colorado River. Fish captured in the reservoir in June of both 1999 (1,091 fish = 100% nonnative) and 2000 (1,420 = 99% nonnative) were measured and given a right pelvic fin clip (except trout) to denote their origin in the reservoir. The net's placement met the screening requirement in the Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin (U.S. Fish and Wildlife Service 1996) and allowed the stocking of bluegill (15,000/yr.; 2 inches long), and largemouth bass (7,000/yr.; 4 inches long) into Highline Lake in 1999, 2000, 2001. All of the largemouth bass stocked into the reservoir each year were also marked with right pelvic fin clips.

Electrofishing to evaluate the net's effectiveness in controlling fish escapement from the reservoir was conducted at four downstream sites:

1. Mack Wash below Highline Lake Dam;
2. Mack Wash near Root's Reservoir;
3. near Salt Creek confluence with Colorado River in 1999 (July-November); and
4. Salt Creek below I-70 in 2000 (May-November) and 2001 (May-October).

Following the net's installation, few fish marked with a right pelvic clip were captured downstream of the reservoir in 1999 (4 of 714 = 0.5%), 2000 (8 of 1,566 = 0.5%), or 2001 (4 of 1,393 = 0.3%) (Table 4). These marked fish captured downstream of the reservoir included 4 green sunfish, 10 largemouth bass, and 1 yellow perch. The sizes of the recaptured largemouth bass indicated that they most likely were from the fish stocked into the reservoir. While the number of largemouth bass captured in the reservoir nearly doubled from 1999 to 2000 (69 to

Table 4. Fish captured and recaptured from sampling in Mack Wash downstream of Highline Lake Dam.

	1999	2000	2001	Total/Mean
All Fish	1,315	1,566	1,393	4,247
Percent Native	11%	44%	35%	30%
Percent Nonnative	89%	56%	65%	70%
Number and Percent LMB	247 (19%)	128 (8%)	19 (1%)	376 (9%)
Number and Percent Marked Fish After Net's Installation	4 of 714 (0.5%)	8 of 1,566 (0.5%)	4 of 1,393 (0.3%)	16 of 3,673 (0.4%)
Species Recaptured Total Lengths	1 YLP, 3 LMB 120–130 mm	1 GSF, 7 LMB 80–130 mm	3 GSF, 1 LMB 108 mm	4 GSF, 10 LMB, 1 YLP

120; Figure 8), the number captured below the dam in 1999 (230) was about half that in 2000 (127) and even lower in 2001 (19) (Figure 9). The low number of marked fish captured below the dam and the declining numbers of most sport fish species captured each year suggests the net was highly effective in controlling fish escapement from the reservoir when properly maintained (Figure 9).

The net also improved fishing at Highline Lake. Stocked largemouth bass and bluegill stayed in the reservoir and did not escape into Salt Wash and the Colorado River. The net was left in place over winter to maintain containment year-around.

Limnological sampling identified an opportunity to reschedule annual maintenance releases from the reservoir's unscreened bottom outlet from early spring to mid-summer when low dissolved oxygen levels precludes or minimizes fish presence in this zone and therefore, escapement from the reservoir. In 2001, the maintenance release was performed in September instead of March. Sampling showed that dissolved oxygen levels had begun to rebound, but cursory sonar observations indicated fish did not occupy the deep water near the outlet. This aspect of the study showed that timing bottom maintenance releases with oxygen depletion in the reservoir can minimize the need for a bottom release screen. In case of emergency or extended bottom releases, it may be necessary to fabricate a bottom release screen "sock" to control fish escapement.

A sample of the net from nearshore, exposed to maximum abrasion and ultra-violet light, was submitted to the net's manufacturer for an evaluation of its remaining strength. The break test revealed a 33% strength loss over the net's 2.5-year service life in the section exposed to maximum abrasion. It is believed that the body of the net has also experienced some strength loss, and it appears appropriate to begin budgeting for the net's impending replacement.

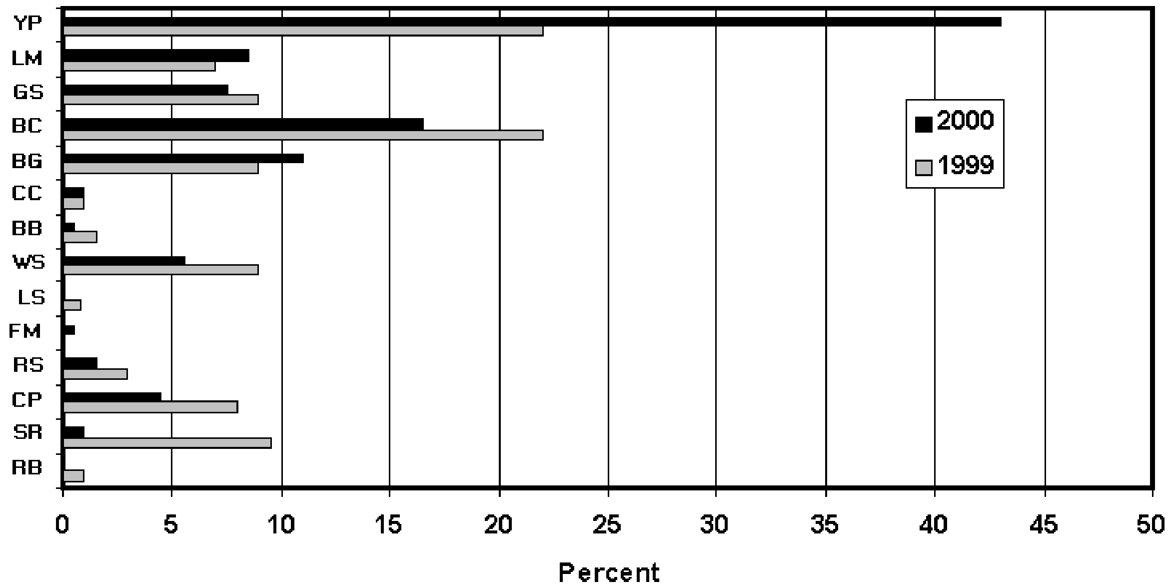


Figure 8. Fish species composition of Highline Lake (1999–2000).

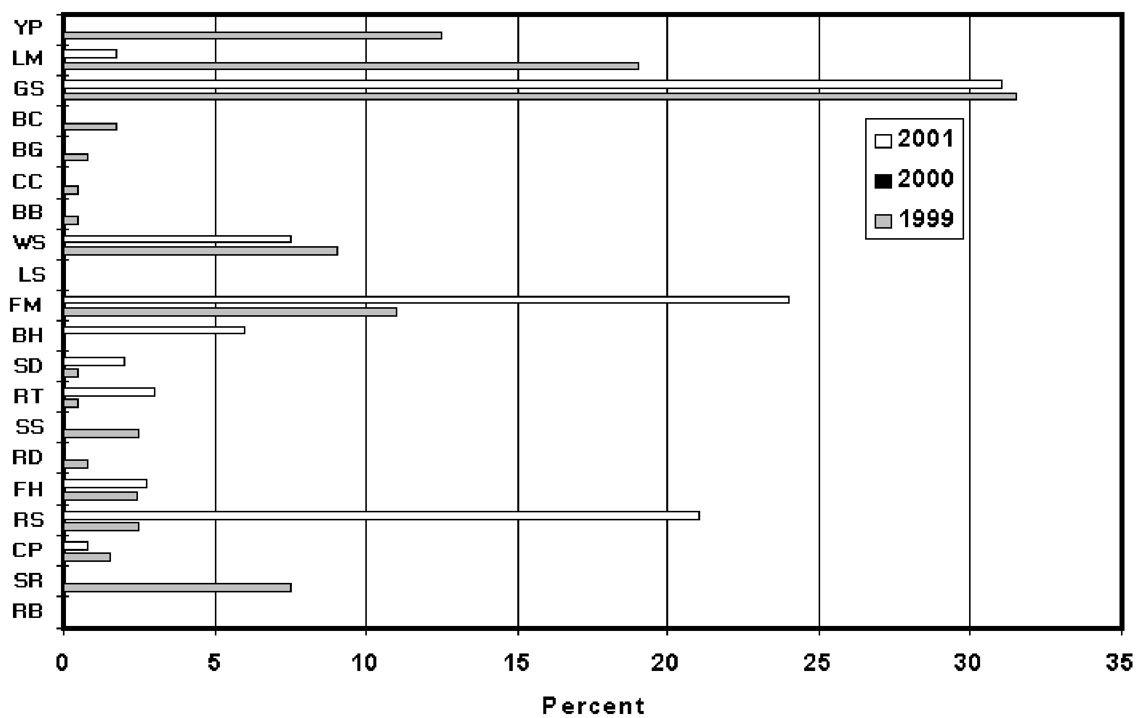


Figure 9. Fish species composition of Mack Wash and Salt Creek (1999–2000).

3.5 Northern Pike Removal

3.5.1 Translocation of Northern Pike From Critical Habitat in the Yampa River (Project No. 98; CDOW, Larval Fish Laboratory/Colorado State University)

Northern pike were translocated from the Yampa River during 1999–2001. The purpose of the translocation was to reduce risk of predation and competition of northern pike on endangered Colorado pikeminnow. The objectives of the project were to (1) remove by translocation northern pike from the Yampa River to Rio Blanco Reservoir (a small reservoir in the White River drainage in northwestern Colorado), and (2) determine the effectiveness of removal through length-frequency analysis and catch-per-unit-effort data.

Northern pike were first introduced into the Yampa River drainage in 1977 when 700 fish were stocked by the Colorado Division of Wildlife into Elkhead Reservoir, an impoundment on Elkhead Creek which is a tributary of the Yampa River just upstream of Craig, Colorado (Figure 10). The first northern pike were reported in the Yampa River in 1979, and guiding services for anglers began in the 1980's (Figure 11). Elkhead Reservoir was drawn down in 1993 and again in 1999, resulting in additional releases of fish into the Yampa River. Northern pike were illegally released into Stagecoach Reservoir in about 1994, an impoundment on the Yampa River upstream of Steamboat Springs, Colorado.

Northern pike were captured during four sampling occasions, each 11 days long. Sampling was conducted during spring runoff when adults were congregated to spawn in or near backwater habitats. Shoreline electrofishing, block and shock, and fyke nets were used to capture fish (Table 5). Shoreline electrofishing with one or two boats covered approximately 75 miles of shoreline. A combination of electrofishing and trammel nets (i.e., block and shock) was used to capture fish in backwaters, and fyke nets were set overnight in backwater habitats.

Although greater numbers of northern pike were captured in backwaters in the first three trips of 2000 (Figure 12), approximately half of all fish were captured in backwaters (52%) and about half were captured in the main channel (48%). In 2001, 70% of the northern pike were captured in the main channel and 30% were captured in backwaters. The majority of northern pike and the majority of Colorado pikeminnow were captured with electrofishing (Figure 13).

A total of 784 northern pike were removed and translocated during 1999–2001, and 246 Colorado pikeminnow were captured and released (Table 5). The ratio of northern pike to Colorado pikeminnow ranged from 1.9:1.0 to 5.3:1.0, for an overall average of 3.2:1.0. A notable change in the range of ratios occurred in the three sample sites between 1988–1991 (1:1–4:1) and 1999–2000 (6:1–11:1) (Figure 14). Ratios for only two sites during 2001 were 2:1 and 3:1. These data are inconclusive as to the trend of either species.

Length-frequency analysis of northern pike captured in 2000 and 2001 (Figure 15) showed a shift to a higher mode in 2001; i.e., fish captured in 2001 were larger than those captured in 2000.

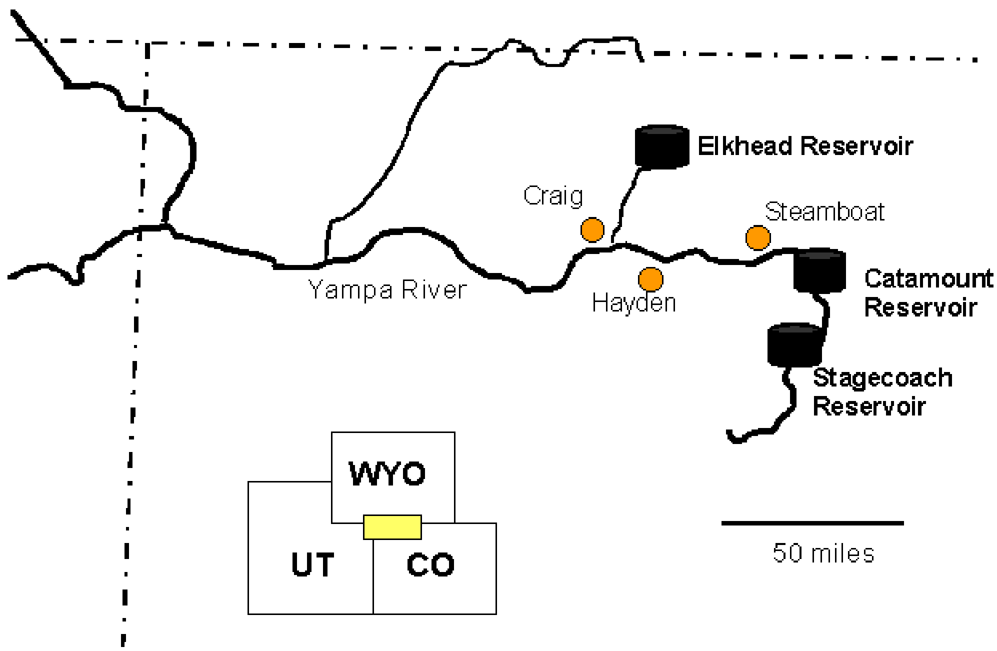


Figure 10. Locations of Elkhead, Stagecoach, and Catamount reservoirs in the Yampa River drainage, Colorado.

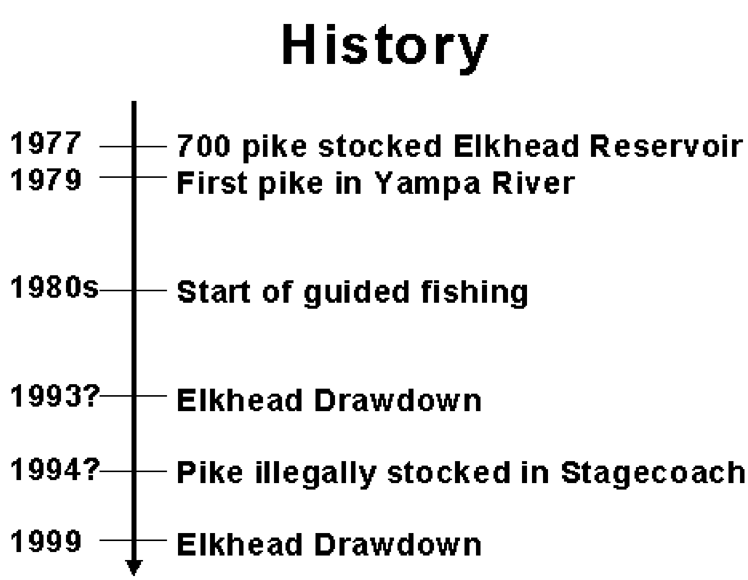


Figure 11. History of northern pike in the Yampa River drainage.

Table 5. Sampling effort and numbers of northern pike and Colorado pikeminnow captured during 1999–2001.

Year	Sampling Effort (samples)		Numbers of Fish Captured		
	Electrofishing	Fyke Nets	Northern Pike	Colorado Pikeminnow	Ratio
1999[a]			72	23	3.1:1.0
2000	61	560	443	83	5.3:1.0
2001	185	250	269	140	1.9:1.0
Totals	246	810	784	246	3.2:1.0

[a]Only block and shock used in 8 backwaters; 14 samples.

Average lengths of northern pike for each of four trips in 2001 were significantly greater than average lengths during the four trips in 2000.

Bite marks were found on all sizes of Colorado pikeminnow examined during 1999–2001, with the largest in the 650–700 mm TL range (Figure 16). During 1999, only about 15% of Colorado pikeminnow had bite marks, but in 2001, approximately 30% had bite marks.

This study concluded that northern pike occurred in concentrations in the Yampa River, primarily in and around backwaters (i.e., floodplain habitats) during spring runoff. Hence, the most effective time and manner for capturing these fish was by sampling in and near backwaters during spring runoff. Northern pike outnumbered Colorado pikeminnow at three sample locations on the Yampa River by about 2–3:1, and 10:1 in some locations. Total numbers of northern pike removed and translocated from the Yampa River during 1999–2001 was 784. Average length of northern pike did not decline on successive sampling occasions; average length in 2000 was 550 mm TL, and average length in 2001 was 600 mm TL. This suggests that removal efforts during 1999–2000 removed the smaller fish, or growth was manifest in the remaining fish and average size 1 year later was greater.

Cursory examination of stomachs and regurgitated contents showed that northern pike prey on large-bodied native fishes, including roundtail chub and flannelmouth sucker. Scars on Colorado pikeminnow were evidence of attempted predation by northern pike on even large pikeminnow. A Lincoln-Petersen mark-recapture estimate yielded an estimated 1,350 northern pike (95% confidence interval = 959–2067; standard error = 261; capture probability = 0.06) in the reach of the Yampa River sampled. Translocation of northern pike from the Yampa River will continue in 2002 and 2003 with continued evaluation of effectiveness of removal.

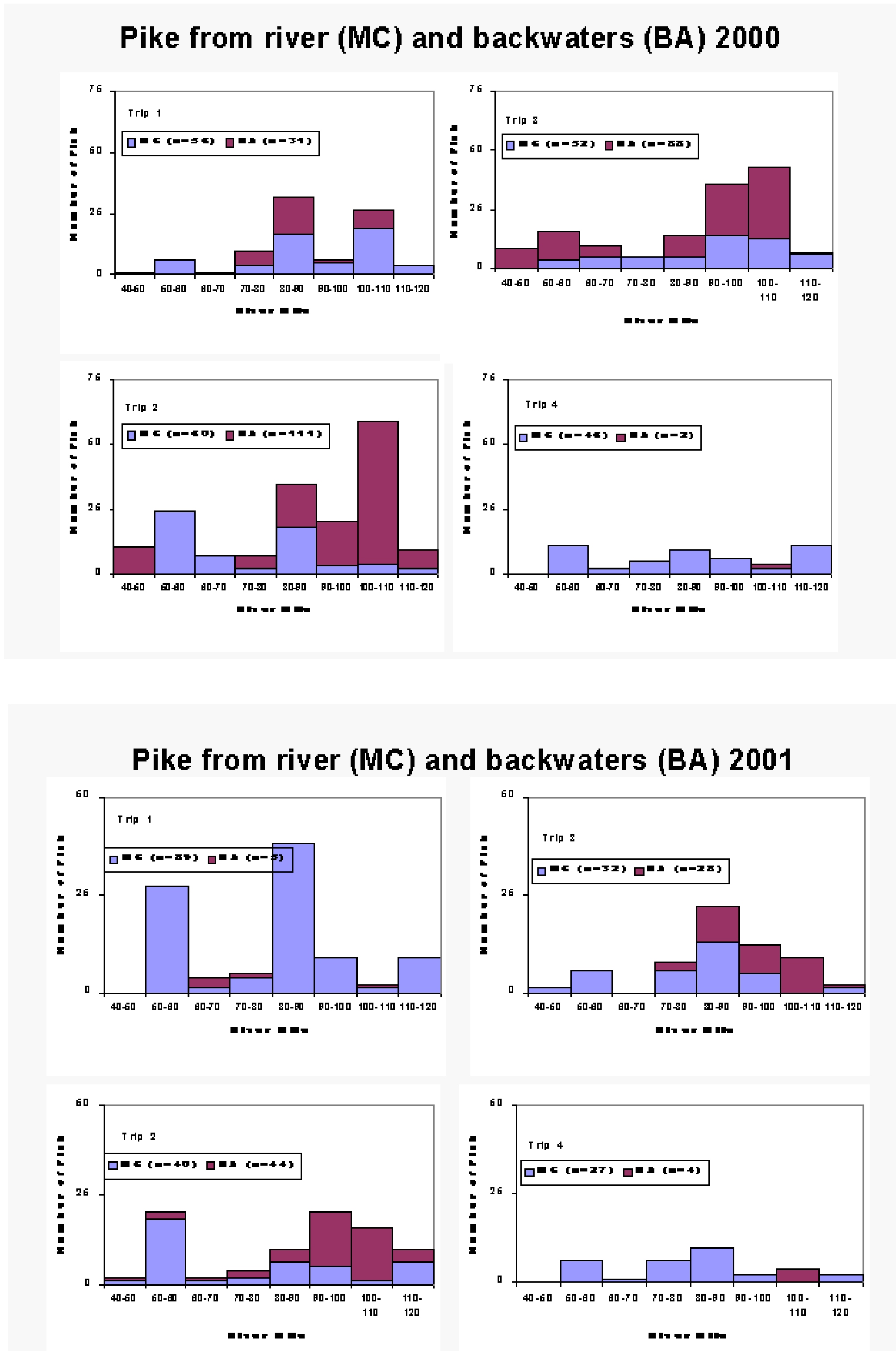
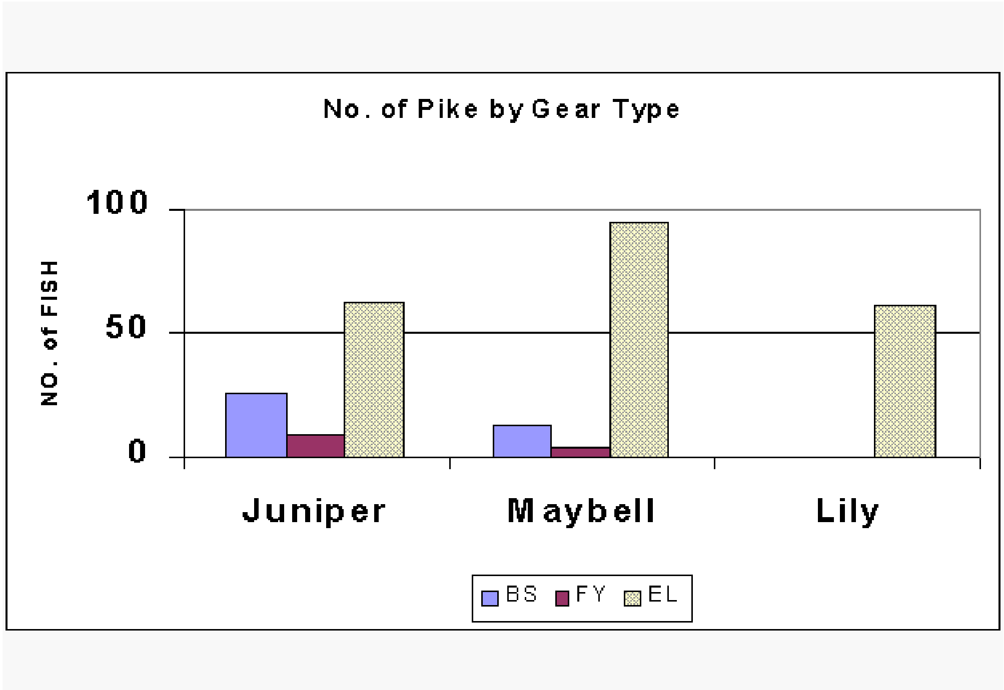


Figure 12. Numbers of northern pike captured from the main channel (MC) of the Yampa River and from backwaters in 2000 and 2001.



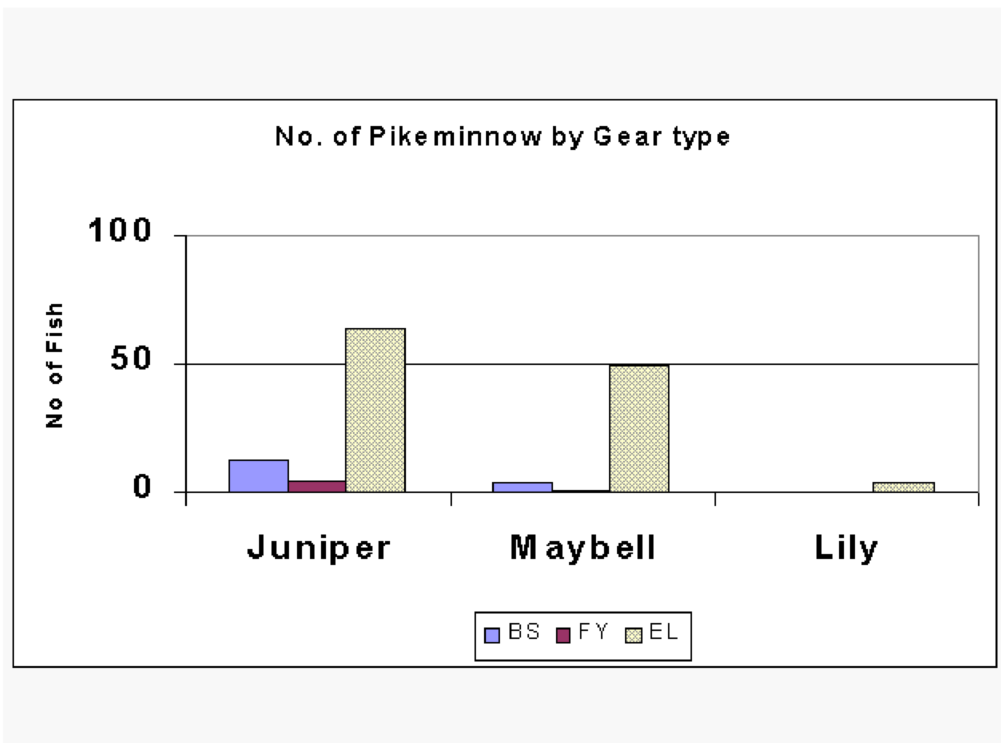
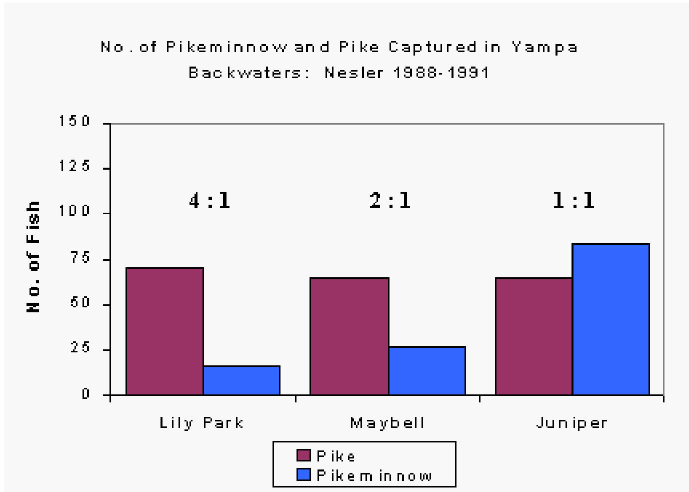
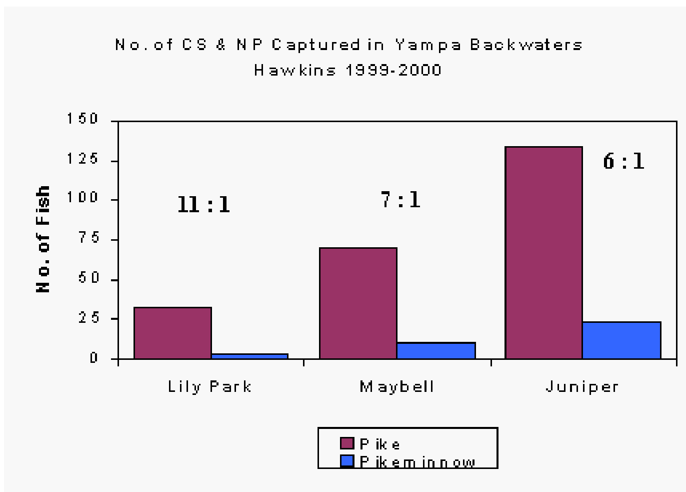


Figure 13. Numbers of northern pike and Colorado pikeminnow captured by gear type at three sites on the Yampa River, 1999–2001. BS = block and shock, FY = fyke net, EL = electrofishing.





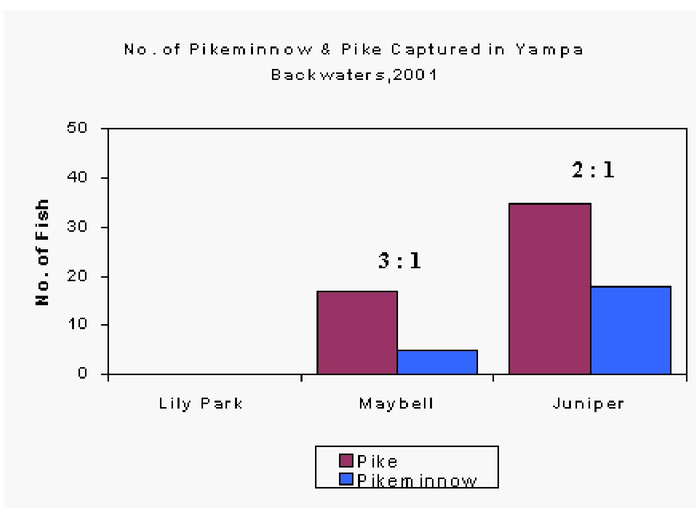
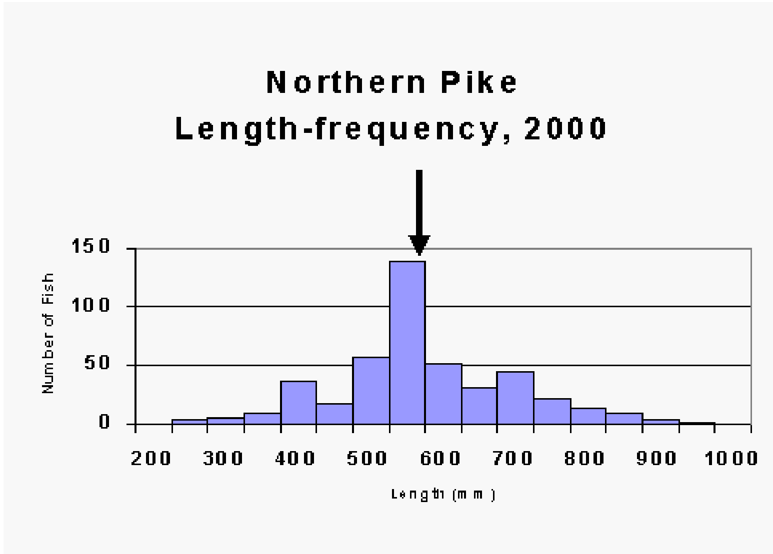
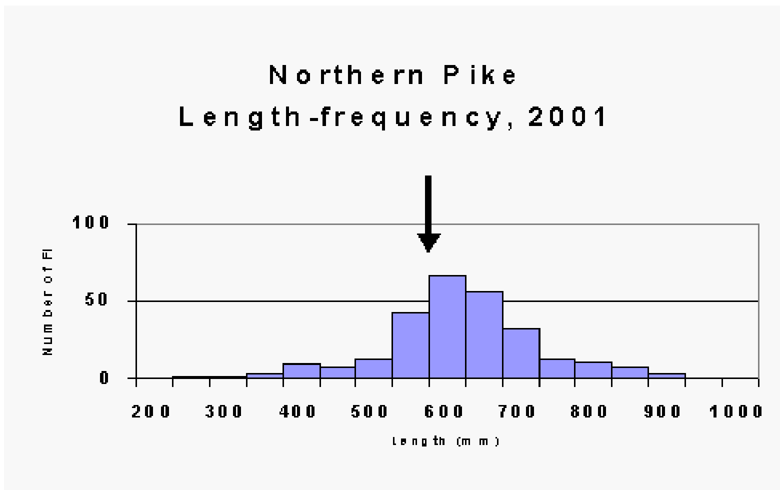


Figure 14. Numbers and ratios of Colorado pikeminnow and northern pike captured in Yampa River backwaters in 1988–1991 (top), 1999–2000 (middle), and 2001 (bottom).





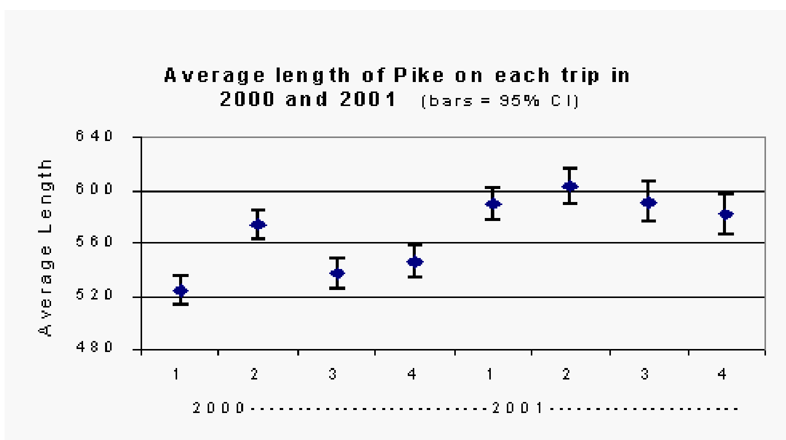


Figure 15. Length-frequency for northern pike in 2000 (top) and 2001 (middle), as well as average length of northern pike on each trip in 2000 and 2001.

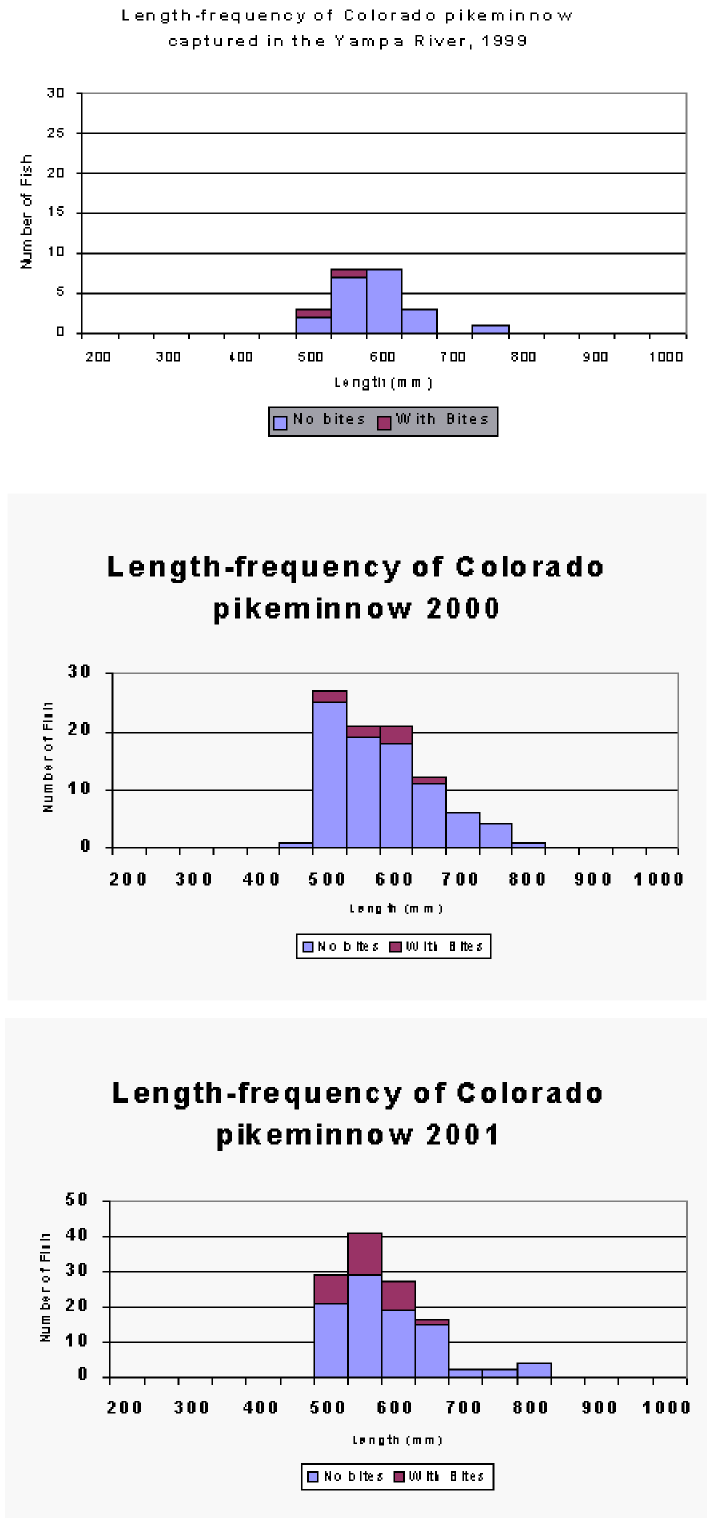


Figure 16. Length-frequency of Colorado pikeminnow during 1999–2001 in the Yampa River and incidence of bite marks, presumably by northern pike.

3.5.2 Fish Community Population Estimates on the Yampa River (CDOW)

Population estimates for three stations on the Yampa River were made between 1998 and 2001 using mark and recapture electrofishing (Figure 17). Fish species composition was documented for stations at Duffy, Sevens, and Lily Park (Tables 6, 8, and 10). Fish density estimates ranged from 316 to 430 fish/km at Duffy; 673 to 1,147 fish/km at Sevens; and 3,468 to 6,279 fish/km at Lily Park (Tables 7 and 9). Native fish were rare in the Duffy reach, with a declining trend over the last 4 years. This appears to be related to low base flows in 2000 and 2001. Densities for all native fish (flannelmouth sucker, bluehead sucker, roundtail chub, Colorado pikeminnow, speckled dace, mottled sculpin) in all Yampa stations have displayed a strong to mild downward trend between 1998 and 2001 (Tables 7, 9, and 11). Minimum flow in the Yampa River was much less in 2000 (30 cfs) and 2001 (50 cfs), compared to 1997 (320 cfs), 1998 (116 cfs), and 1999 (166 cfs). Effect of predation by northern pike may not have been as significant in 2000 and 2001 since their numbers were much less than in prior years at both the Sevens and Duffy stations. In 2001, smallmouth bass was the only species in the Yampa River to display large increases in abundance for both young-of-year (YOY) and older fish. Numbers of YOY smallmouth bass in 2001 in the Duffy reach were near 4,000/station compared to 700/station in the prior 3 years. Smallmouth bass over 12 cm became the dominated species at Duffy for the first time (Figures 18, 19, 20, and 21). Also, smallmouth bass composition strongly increased at Sevens and Lily Park in 2001. This suggests that habitat availability for smallmouth bass increased during low flow years.

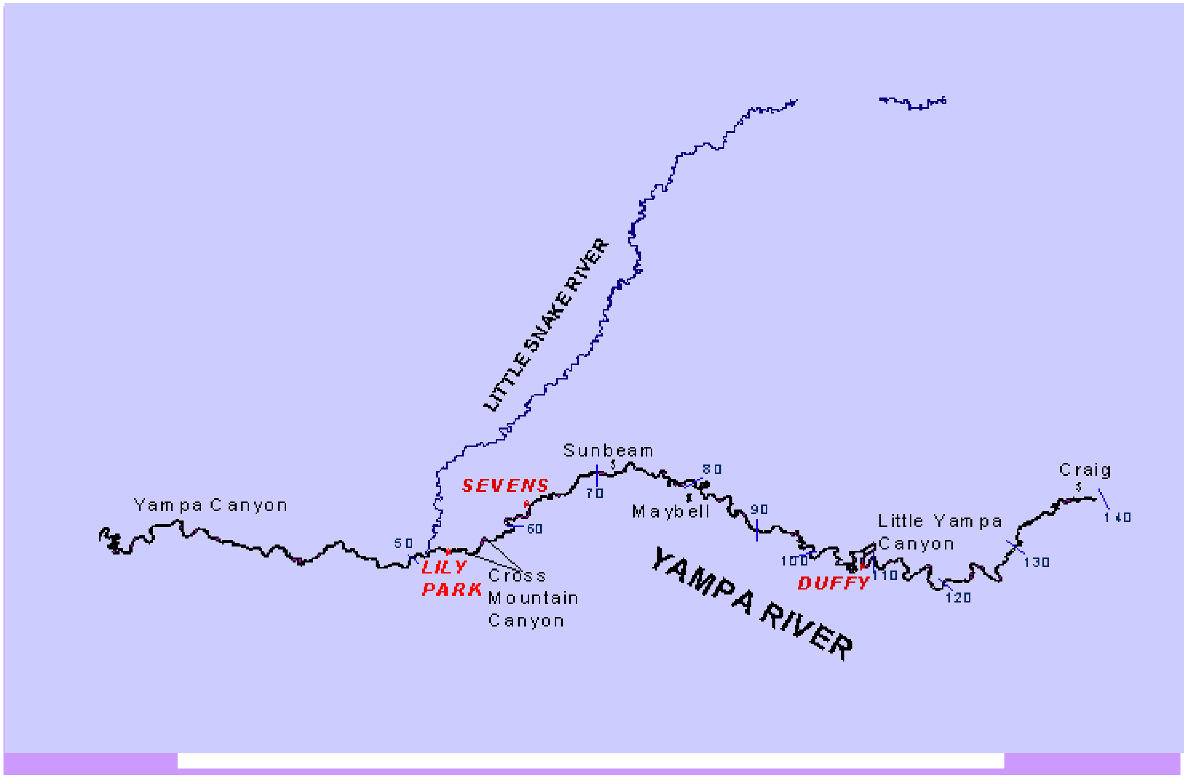


Figure 17. Study areas for population estimates of the fish community in the Yampa River.

Table 6. Fish species composition (number and percent) in the Duffy Reach of the Yampa River, RM 108–111 (4.5 km), by electrofishing.

Species	1998	1999	2000	2001
Number and Percent Fish Caught and Counted Over 15 cm Total Length				
FM	77 (5.3%)	59 (5.1%)	50 (5.0%)	15 (2.0%
BH	49 (4.4%)	82 (5.6%)	42 (3.5%)	37 (4.4%)
RTC	42 (3.3%)	40(2.9%)	30 (3.6%)	24 (3.1%)
CPM	19 (1.5%)	13 (0.6%)	10 (0.8%)	5 (0.6%)
WSWX	832 (68.9%)	875 (72.0%)	740 (72.5%)	376 (49.5%)
SMB	74 (8.2%)	87 (6.3%)	112 (9.6%)	254 (32.4 %)
NP	38 (2.8%)	41 (2.3%)	10 (0.9%)	9 (1.0%)
CC	39 (3.0%)	75 (4.0%)	39 (3.2%)	37 (4.4%)
CP	27 (2.7%)	20 (1.1%)	9 (0.8%)	12 (2.2%)
Nonnative	85.6%	85.7%	87.0%	89.8%
Number and Percent Fish Caught and Counted Under 15 cm Total Length				
SD	11.0%	8.1%	1.2%	0.2%
MS	18.7%	26.5%	4.7%	0.75%
SMB yoy	45.4%	42.1%	83.5%	98.0%
WS	9.8%	18.4%	5.8%	0.75%
SS	14.0%	2.4%	1.3%	0.2%

Table 7. Estimates of fish density in the Duffy Reach of the Yampa River, RM 108–111 (4.5 km). Density as fish over 15 cm total length/km (total number caught without recaptures).

Species	1998	1999	2000	2001
FM	25 (77)	15 (59)	11 (50)	5 (15)[a]
BH	24 (49)	23 (82)	16 (42)	19 (37)
RTC	12 (42)	25 (40)	5 (30)	10 (24)
CPM	8 (19)	5 (13)	4 (10)	3 (5)
WSWX	241 (832)	242 (875)	203 (740)	185 (376)[a]
SMB	40 (74)	58 (87)	58 (112)	215 (254)[a, b]
NP	17 (38)	16 (41)	3 (10)	4 (9)[b]
CC	19 (39)	29 (75)	15 (39)	23 (23)
CP	22 (27)	8 (20)	4 (9)	2 (12)
SD	(163)	(143)	(11)	(8)[a, c]
MS	(277)	(467)	(44)	(28)[a, c]
SMB yoy	(504)	(703)	(771)	(3,698)[a]
TOTAL	387	403	316	430

[a] = trend possibly flow related
[b] = trend possibly management related
[c] = deliberate effort to catch all fish

Table 8. Fish species composition (number and percent) in the Sevens Reach of the Yampa River, RM 60–62 (2.9 km), by electrofishing.

Species	1998	1999	2000	2001
Number and Percent Fish Caught and Counted Over 15 cm Total Length				
FM	668 (47.0 %)	476 (45.8 %)	403 (49.8 %)	359 (53.1 %)
BH	314 (21.0 %)	187 (18.0 %)	180 (22.2 %)	89 (13.2 %)
RTC	73 (5.7 %)	39 (3.8 %)	31 (3.8 %)	23 (3.4 %)
CPM	3 (0.2 %)	2 (0.2 %)	2 (0.2 %)	0 (0.0 %)
WSWX	158 (13.0 %)	152 (14.6 %)	138 (17.0 %)	106 (15.6 %)
SMB	14 (1.0 %)	20 (2.5 %)	4 (0.5 %)	27 (5.0 %)
NP	21 (1.5 %)	17 (1.8 %)	2 (0.2 %)	2 (0.3 %)
CC	86 (6.4 %)	74 (7.2 %)	15 (1.9 %)	35 (5.2 %)
CP	53 (3.9 %)	47 (4.8 %)	30 (3.8 %)	25 (4.1 %)
Nonnative	26.1 %	32.2 %	24.0 %	30.3 %
Number and Percent Fish Caught and Counted Under 15 cm Total Length				
SD	37.5 %	13.2 %	2.4 %	2.0 %
MS	5.0 %	0 %	0 %	0.0 %
SMB yoy	0.3 %	26.3 %	14.3 %	58.3 %
WS	6.2 %	18.4 %	26.9 %	6.0 %
SS	42.1 %	35.5 %	59.9 %	33.8 %

Table 9. Estimates of fish density in the Sevens Reach of the Yampa River, RM 60-62 (2.9 km). Density as fish over 15 cm total length/km (total number caught without recaptures).

Species	1998	1999	2000	2001
FM	395 (668)	376 (476)	296 (403)	263 (359)[a]
BH	274 (314)	238 (187)	309 (180)	120 (89)[a]
RTC	73 (73)	41 (39)	54 (31)	29 (23)
CPM	4 (3)	3 (2)	3 (2)	0 (0)
WSWX	200 (158)	190 (152)	106 (138)	138 (106)[a]
SMB	20 (14)	29 (20)	3 (4)	37 (27)
NP	62 (21)	22 (17)	3 (2)	3 (2)[b]
CC	111 (86)	109 (74)	22 (15)[a]	46 (35)
CP	77 (53)	69 (47)	45 (30)	33 (25)
SD	(79)	(10)	(11)	(3)[a, c]
MS	(12)	(0)	(0)	(0)[c]
SMB yoy	(1)	(3)	(64)	(82)[a]
TOTAL	1147	1115	778	673

[a] = trend possibly flow related
[b] = trend possibly management related
[c] = deliberate effort to catch all fish

Table 10. Fish species composition (number and percent) in the Lily Park Reach of the Yampa River, RM 51 (2.9 km), by electrofishing.

Species	2000	2001
Number and Percent Fish Caught and Counted Over 15 cm Total Length		
FM	1,734 (47.8 %)	1,753 (67.7 %)
BH	322 (8.5 %)	199 (7.1 %)
RTC	1 (0.03 %)	1 (0.03 %)
CPM	3 (0.07 %)	1 (0.03 %)
WSWX	10 (0.3 %)	4 (0.2 %)
SMB	31 (0.8 %)	144 (5.1 %)
NP	8 (0.2 %)	5 (0.2 %)
CC	1,544 (40.2 %)	507 (17.7 %)
CP	82 (2.1 %)	62 (2.1 %)
Number and Percent Fish Caught and Counted Under 15 cm Total Length		
SD	3 (1.7 %)	0 %
MS	18 (10.3 %)	6 (3.7 %)
SMB yoy	139 (79.7 %)	107 (78.9 %)
WS	0.6 %	1.2 %
SS	5.2 %	15.2 %

Table 11. Estimates of fish density in the Lily Park Reach of the Yampa River, RM 51 (2.9 km). Density as fish over 15 cm total length/km (number caught without recaptures).

Species	2000	2001
FM	2,238 (1734)[b]	1,667 (1753)
BH	552 (322)	346 (199)
RTC	2 (1)	2 (1)
CPM	5 (3)	2 (1)
WSWX	14 (10)	2 (4)
SMB	121 (31)	501 (144)[a]
NP	19 (8)	14 (5)
CC	3,668 (1544)[b]	1,395 (507)
CP	186 (82)	171 (62)
SD	(3)	(0)[c]
MS	(18)	(6)[c]
SMB yoy	(139)	(107)
TOTAL	6279	3468

[a] = trend possibly flow related
[b] = trend possibly management related
[c] = deliberate effort to catch all fish

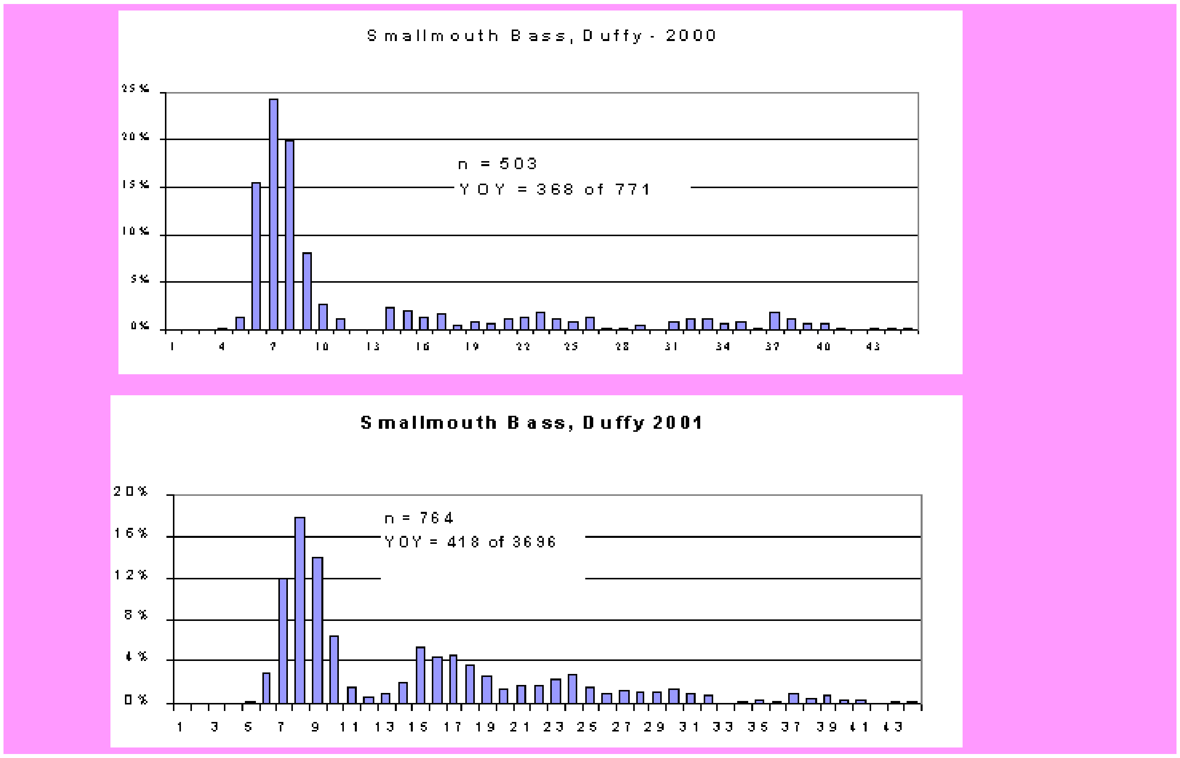


Figure 18. Total length (centimeters) of smallmouth bass captured in the Duffy Reach of the Yampa River for 1998, 1999, 2000, and 2001.

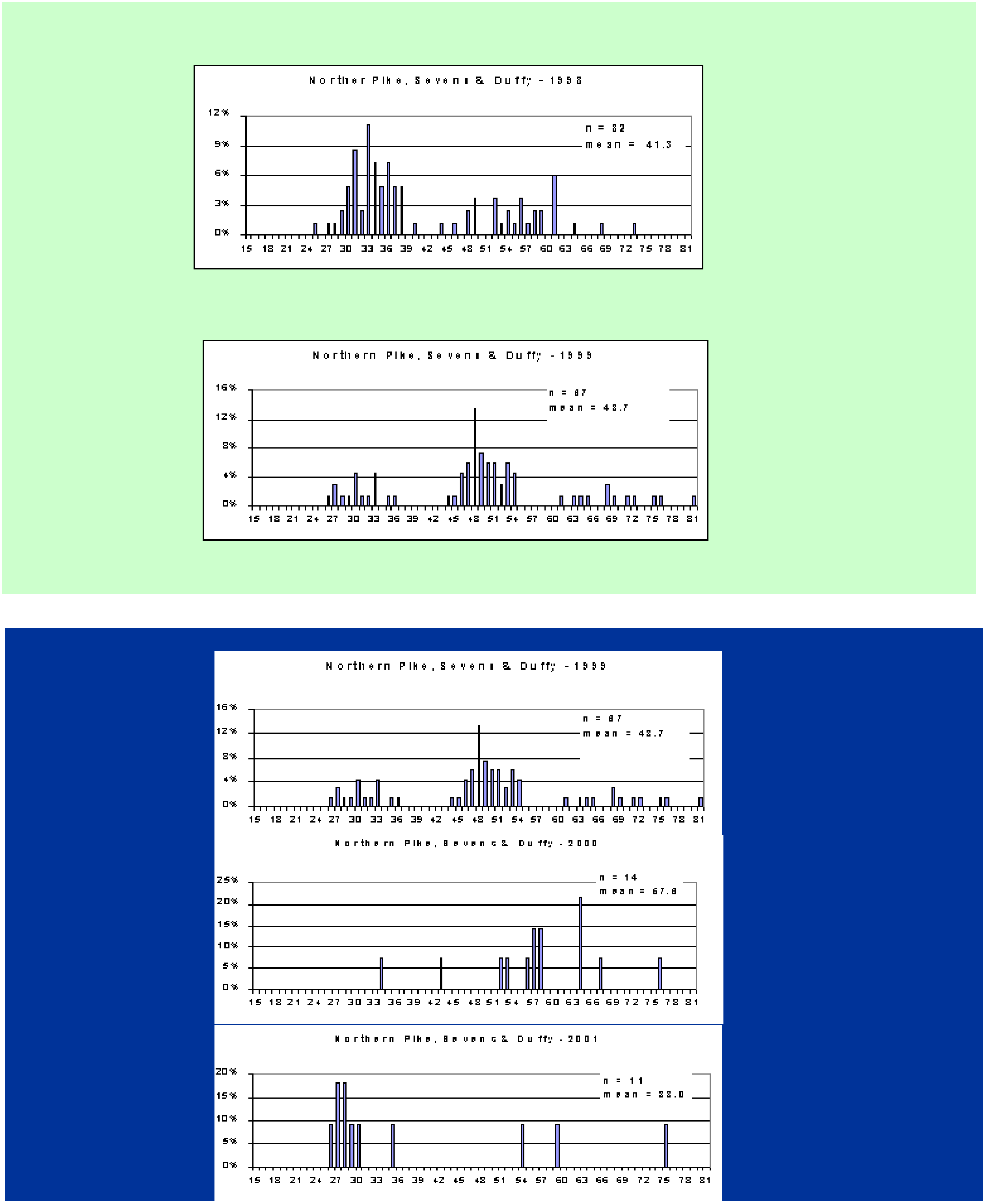


Figure 19. Total length (centimeters) of northern pike captured in the Sevens and Duffy reaches of the Yampa River for 1998, 1999, 2000, and 2001.

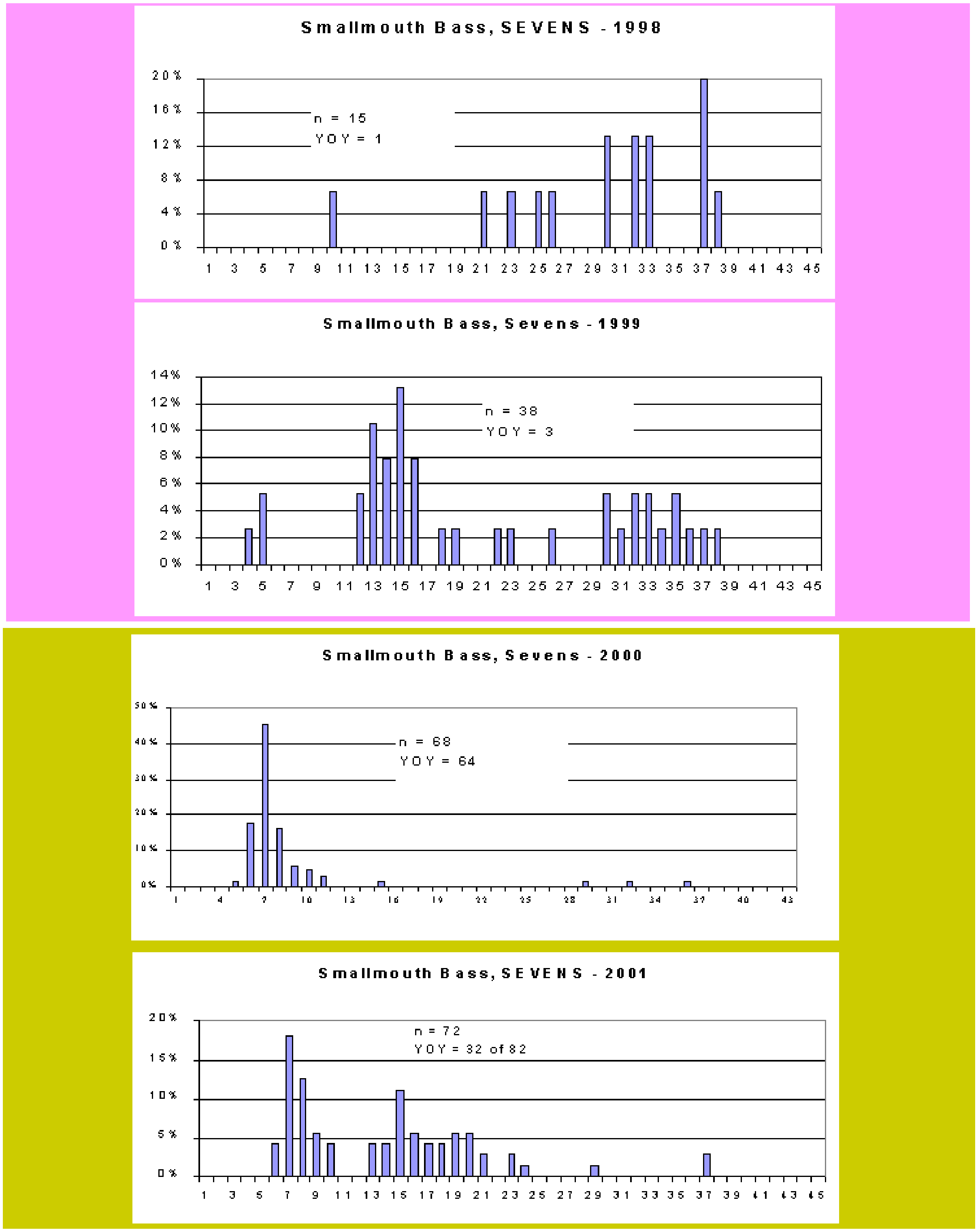


Figure 20. Total length (centimeters) of smallmouth bass captured in the Sevens Reach of the Yampa River for 1998, 1999, 2000, and 2001.

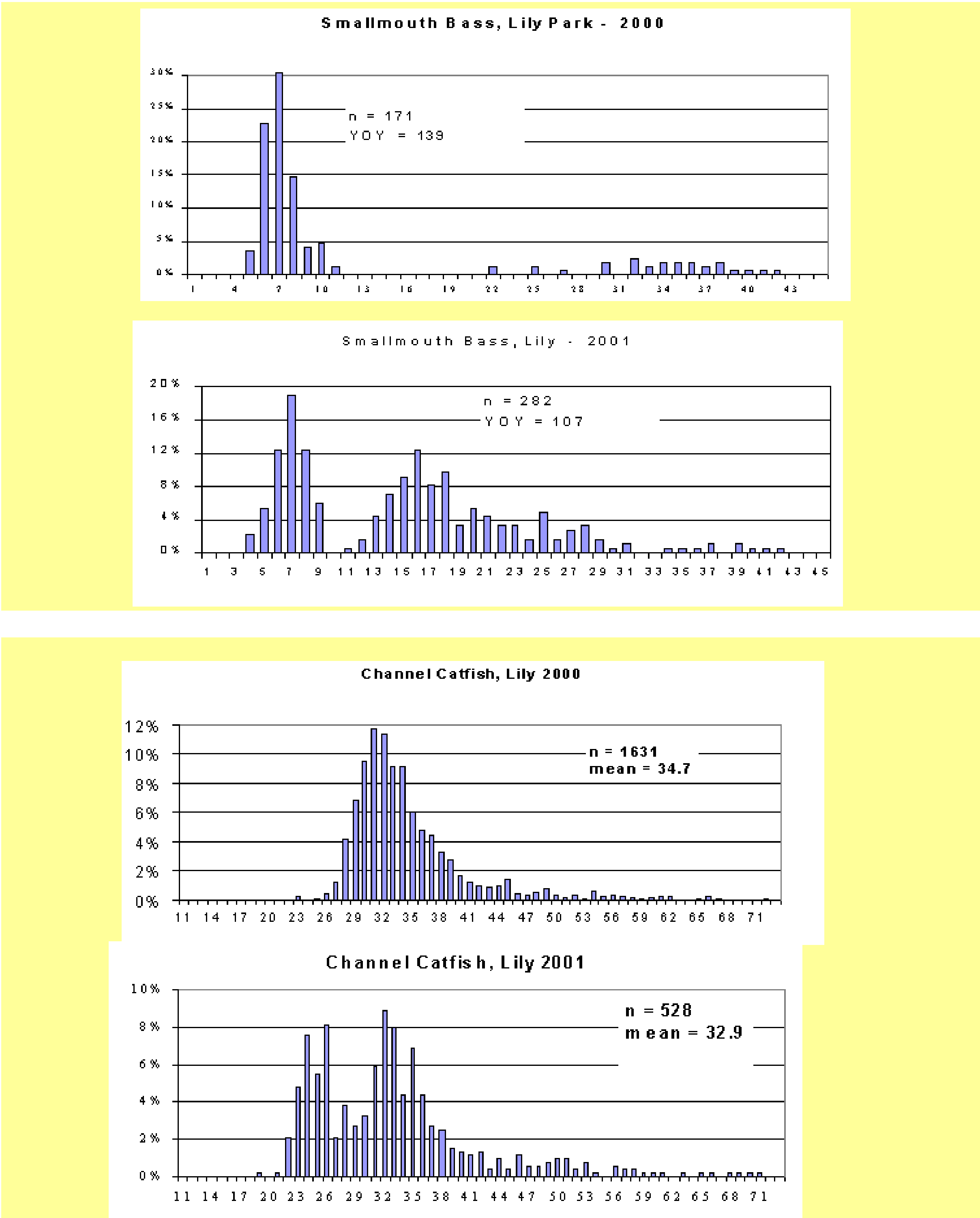


Figure 21. Total length (centimeters) of smallmouth bass and channel catfish captured in the Lily Park Reach of the Yampa River for 2000 and 2001.

3.5.3 Translocation of Northern Pike from the upper Yampa River (upstream of Craig, Colorado) (Project No. 98a; USFWS-CRFP)

The Yampa River upstream from Craig, Colorado, was sampled from April 25 through June 7, 2001 (Figure 22). All sampling was done by placing fyke nets in backwaters, sloughs, and other quiet water habitats that might attract northern pike. Sampling was restricted to river reaches contained within the Colorado Division of Wildlife's Yampa State Wildlife Area (YSWA) and the Nature Conservancy's Carpenter Ranch. Fyke nets were run every day except for weekends. Fyke nets were moved when habitat conditions changed or catch rates of northern pike decreased. In addition to the northern pike, about 1,000 white suckers were removed from the river.

A total of 230 northern pike were captured and removed from the river (Figure 23). Catch rates were highest in the river near Carpenter Ranch where 195 fish were captured. A total of 35 northern pike were removed from the YSWA. A large slough on the YSWA that contained large numbers of northern pike was not sampled at the request of CDOW to avoid conflicts with heavy angler use. Catch rates were highest prior to the ascending limb of runoff (Figure 24). The majority of northern pike captured were between about 550 and 700 mm TL (Figure 25). A total of 40 northern pike were sacrificed by CDOW for food habits analysis. The remainder of the fish (excluding four mortalities) were stocked into ponds in the YSWA. Local anglers were notified that the fish were being placed in the ponds and the ponds subsequently received high angler pressure.

All fish were tagged before being released into the fishing ponds. One of those fish was subsequently recaptured in the Yampa River. It is not known whether an angler moved the fish to the river or if the fish escaped from a pond during the short period when it was connected to the river through a shallow slough.

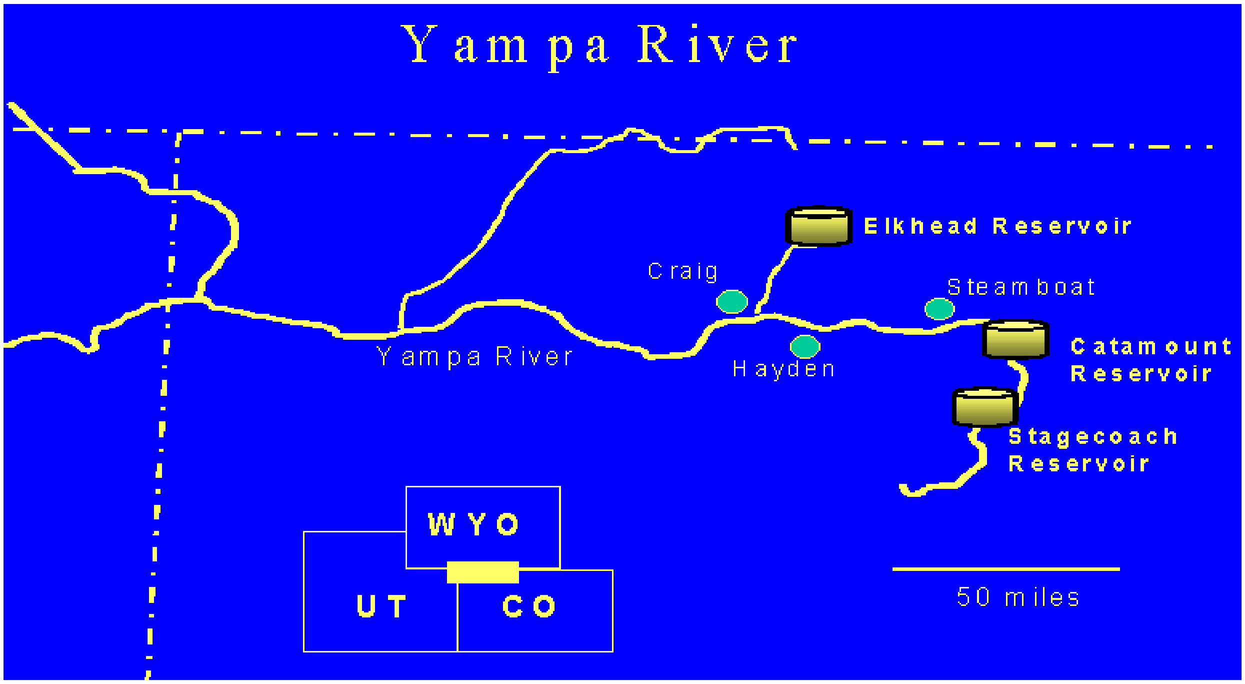


Figure 22. Sampling area for removal of northern pike from the Yampa River upstream of Craig, Colorado.

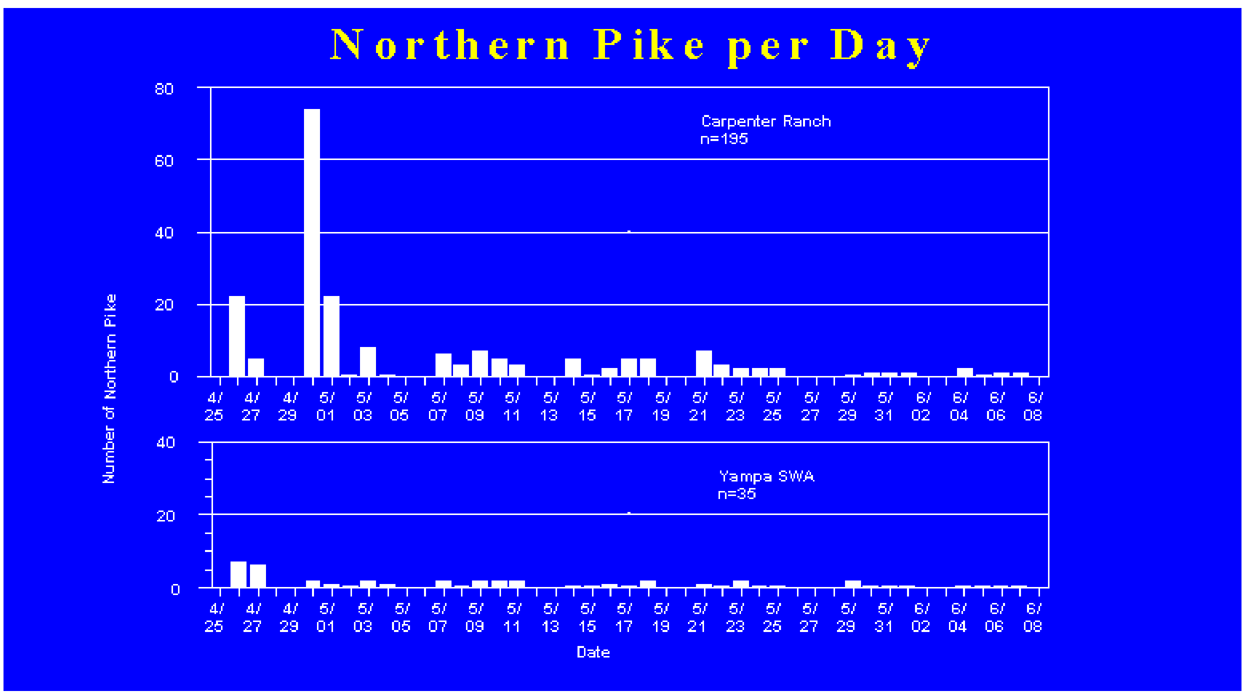


Figure 23. Number of northern pike removed per day from Carpenter Ranch and the Yampa State Wildlife Area.

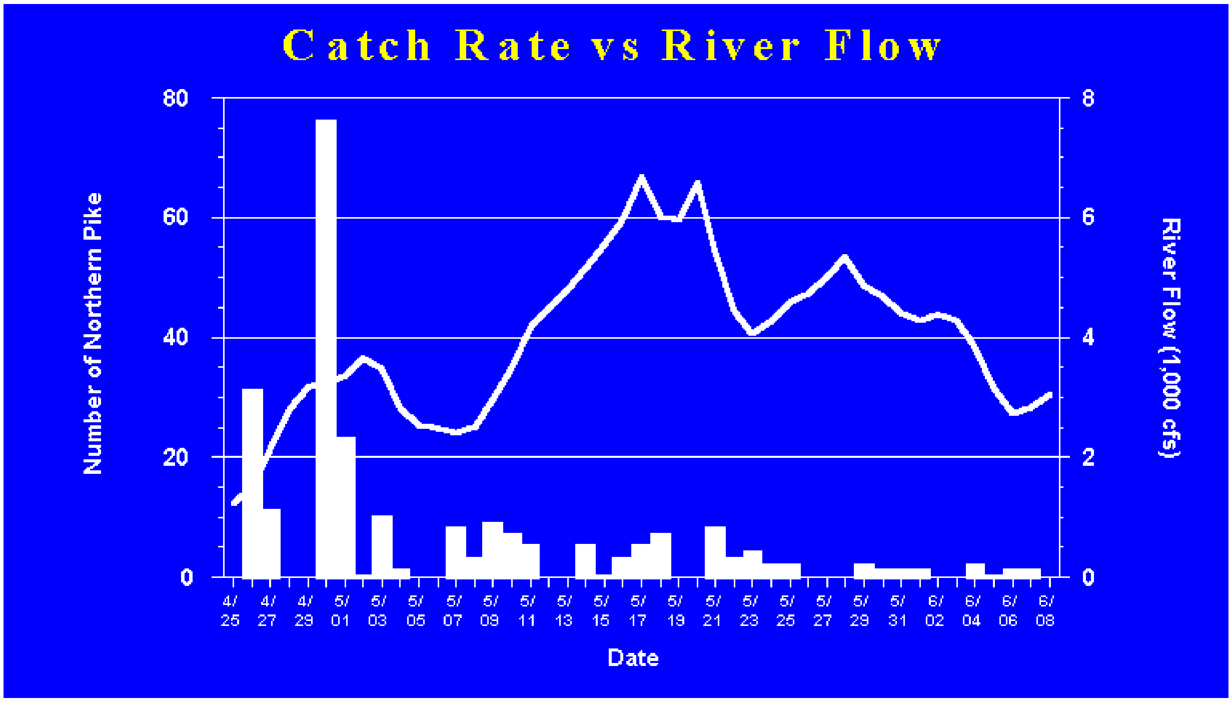


Figure 24. Catch rate of northern pike vs. flow of the Yampa River.

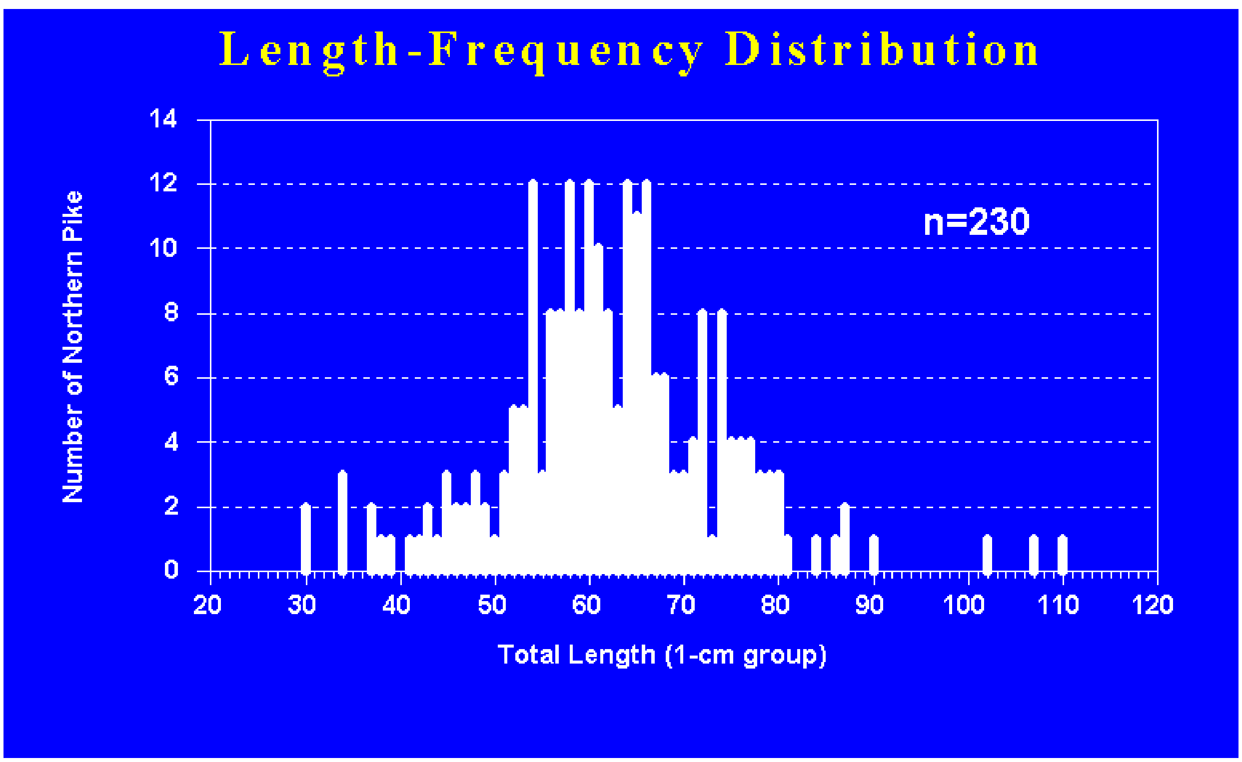


Figure 25. Length-frequency distribution of northern pike captured in the Yampa River.

3.5.4 Removal of Northern Pike from the Gunnison River (Project No. 58; USFWS-Grand Junction)

Northern pike were first stocked into Paonia Reservoir on the North Fork of the Gunnison River by the Colorado Division of Wildlife in 1969 and 1971. Some fish escaped and a small number of northern pike became established within critical habitat on the Gunnison River near Delta, Colorado. No reproduction has been documented in the Gunnison River and the population apparently is maintained by continued escapement from Paonia Reservoir. This study was conducted to determine if the population of northern pike could be substantially reduced through mechanical removal.

Previous work identified a 16-km reach of the Gunnison River downstream from Hartland Diversion where most northern pike were captured (Figure 26). Sampling targeted that reach and was concentrated in spring when high water provided quiet, off-channel habitats that were believed to attract northern pike. Workers used electrofishing, fyke nets, and trammel nets to intensively sample areas where northern pike had been collected in the past.

A total of 10 northern pike were captured and removed from the study area in 1995 and 1996. Six of these fish were captured on the first day of sampling in 1995. Intensive sampling by two-person crews for 27 more days yielded only three more northern pike (Figure 27). Thirteen days of sampling in 1996 yielded only one northern pike, and one pike was observed but not captured. In contrast with other studies, shoreline electrofishing was the most effective sampling technique for collecting northern pike (Figure 28). The majority of northern pike captured were between about 510 and 850 mm TL (Figure 29).

The abrupt decline in catch rate and the sustained low catch in 1996 indicate that most northern pike were removed from this reach of the Gunnison River. It is unlikely that all northern pike occupying the area were removed, but the study shows that a small population with limited recruitment can be substantially reduced with mechanical means.

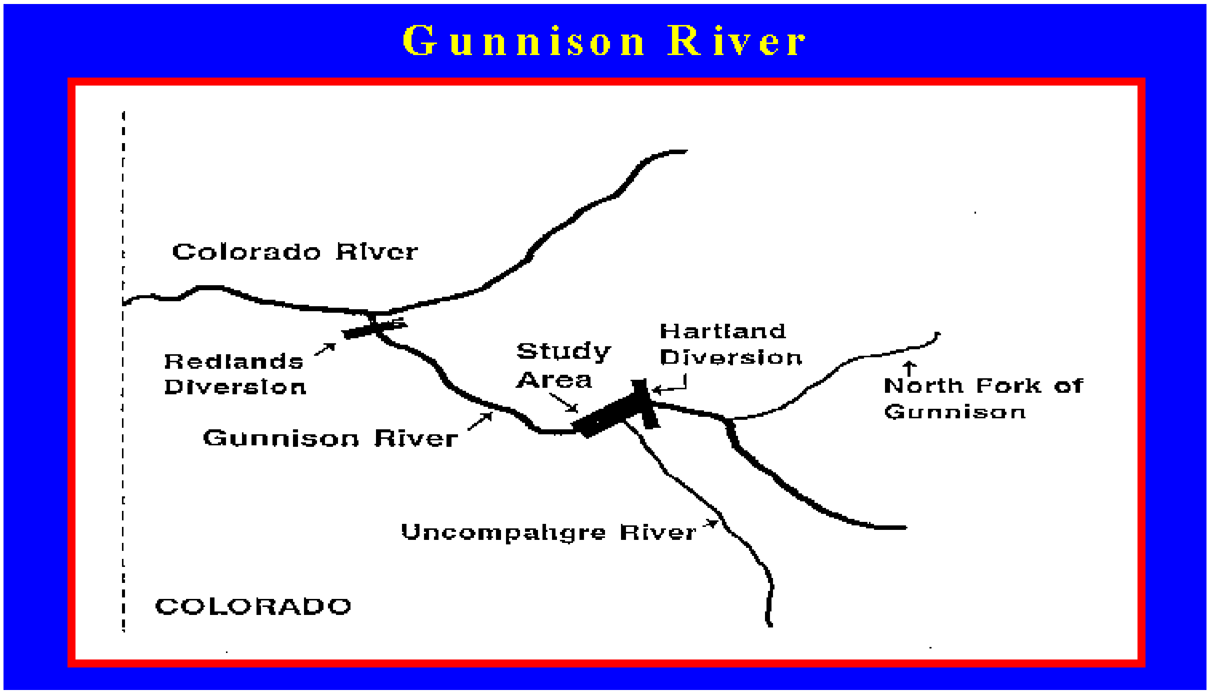


Figure 26. Study area for removal of northern pike below Hartland Diversion on the Gunnison River.

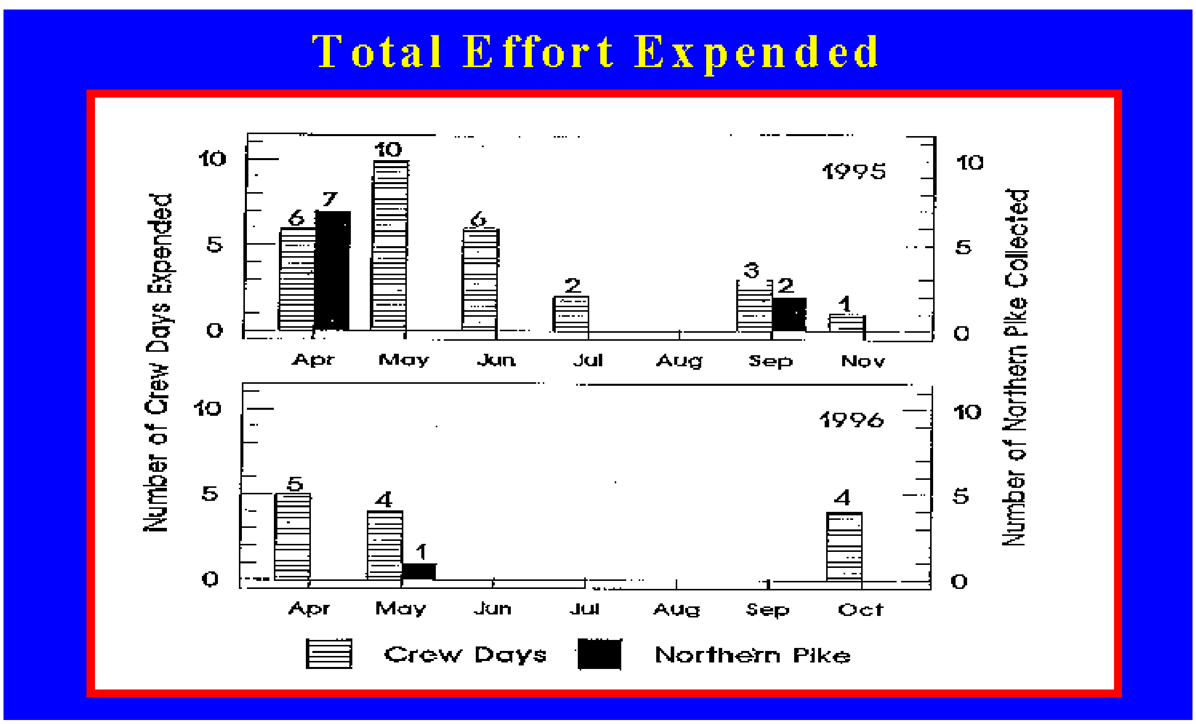


Figure 27. Total effort expended at capturing northern pike on the Gunnison River, 1995–96.

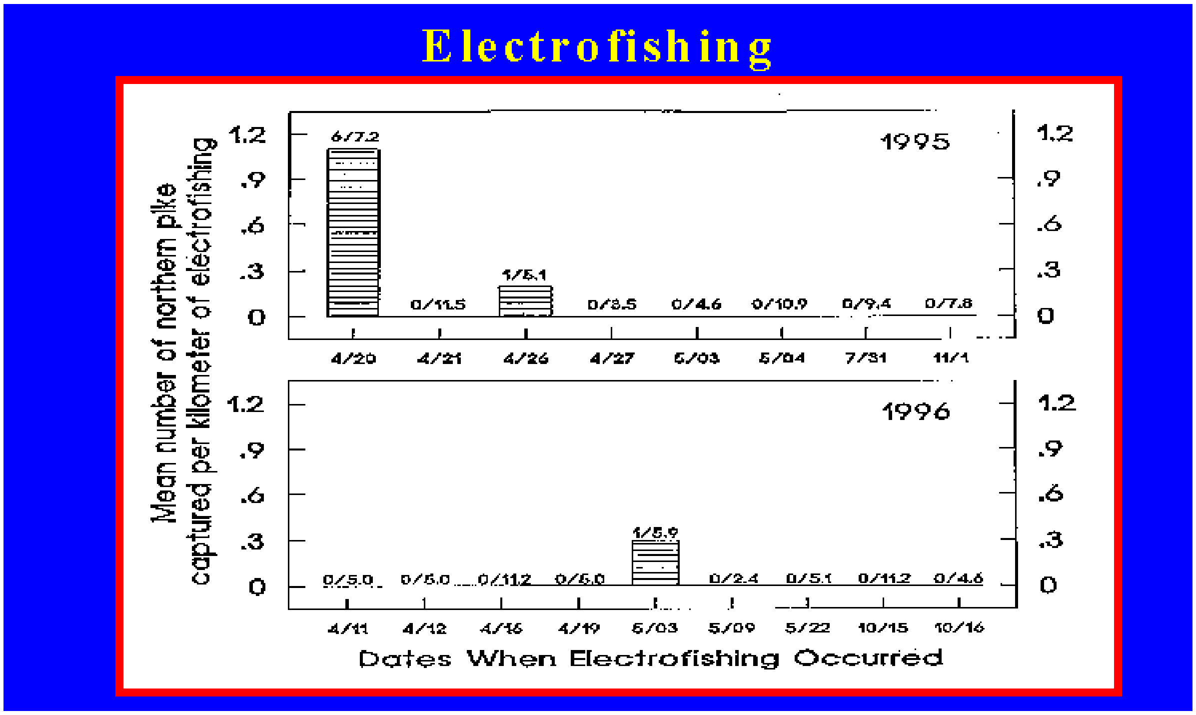


Figure 28. Mean number of northern pike captured per kilometer of electrofishing in the Gunnison River, 1995–96.

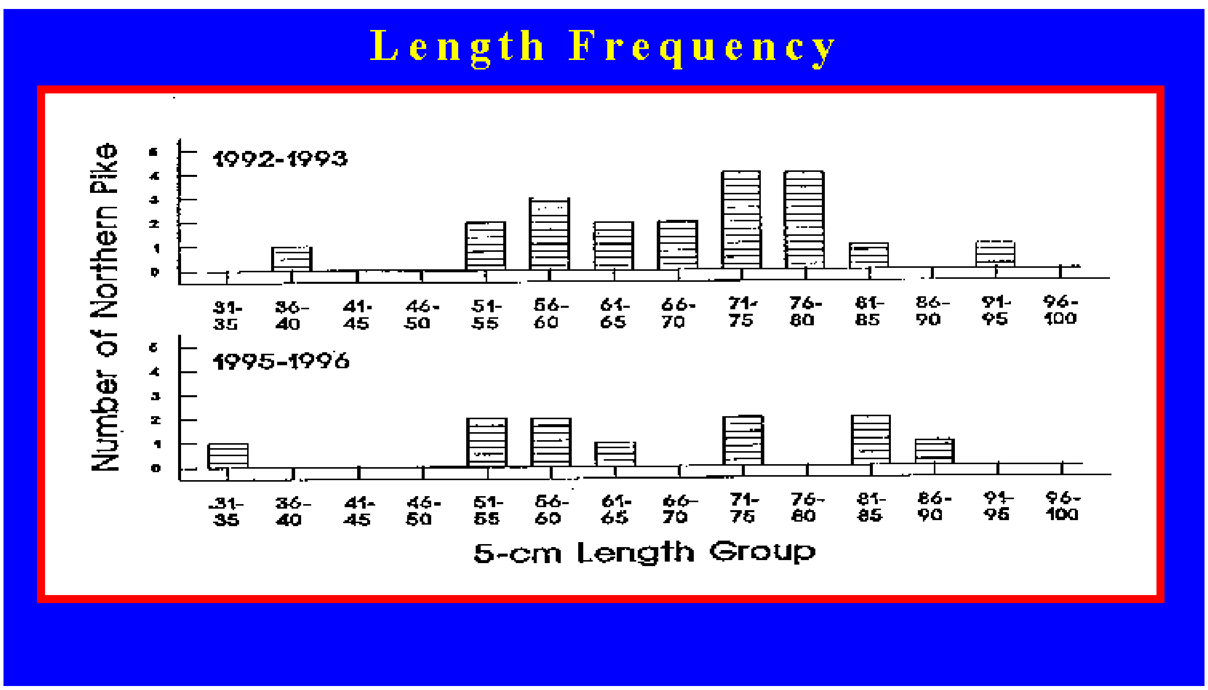


Figure 29. Length-frequency distribution of northern pike captured in the Gunnison River.

3.5.5 Development of Northern Pike Control Program in the Middle Green River (Project No. 109; Utah Division of Wildlife Resources [UDWR] Vernal)

Northern pike were introduced as a gamefish into Elkhead Reservoir, Colorado, in 1977. Since then, the fish have escaped from the reservoir and become established as a reproducing population in the Yampa River and have expanded in number and range within the Yampa River and the Green River. Efforts to control northern pike in the middle Green River were initiated in late March of 2001 and continued through mid-June. The goal of this project was to initiate active control of adult northern pike in the middle Green River and to develop an effective control program to sufficiently reduce predatory and competitive impacts on growth, recruitment, and survival of endangered and other native fishes. The objectives to achieve this include:

- capture and remove adult northern pike to reduce abundance in the middle Green River;
- determine the efficiency of removal efforts; and
- identify the means and levels of northern pike control necessary to minimize the threat of predation and competition on endangered and other native fishes.

The study area extended from the mouth of Whirlpool Canyon in Island Park through Rainbow Park and continued from the mouth of Split Mountain to the confluence of the White River (approximately 70 river miles). Northern pike were removed from known concentrations areas of the middle Green River, including the mouth of Brush Creek, Cliff Creek, Stewart Lake Drain, Ashley Creek, Sportsman Drain, and the mouth of the Duchesne River. Other habitats sampled were large, relatively deep backwaters and shoreline areas. Sampling gear used included fyke nets, trammel nets, and electrofishing. Trammel nets were regularly used in conjunction with electrofishing as a productive sample method.

A total of 251 northern pike was removed from the middle Green River from March through June 2001 (Figure 30). Of six sample locations, greatest number of northern pike captured was at Jensen (Figure 31). Total lengths (TL) of northern pike ranged from 175 mm To 950 mm with an average of 612 mm (Figure 32). Age analysis using cleithra removed from northern pike indicates that the presence of year classes 1 through 10. Most northern pike collected were from the 2 through 4-year age classes and ranged from 400 to 800 mm TL (Figure 33). Catch rates of northern pike were the highest during initial removal efforts in late March and steadily decreased with subsequent removal efforts. Catch rates peaked in early April with 58 northern pike caught in a 1-week period and declined to zero by early June. The decline in catch rates may have been related to the increasing flows as a result of the increase in available habitat which would tend to disperse the northern pike. However, it is hoped that removal efforts played a major part in the decline in catch rates.

The total number of northern pike removed by gear type was nearly equal between electrofishing and the use of fyke nets (Table 12). Electrofishing resulted in a catch rate of 1.67 pike/hr while the use of fyke nets resulted in 0.4 pike/net night. Electrofishing had a total effort efficiency of 0.56 pike/man-hour, while the total effort efficiency of fyke nets was 0.57 pike/man-hour.

Channel catfish were the most abundant nonnative species encountered in the study area (n = 1,170), followed by northern pike (n = 251), smallmouth bass (n = 91), and walleye (n = 33). The most abundant native species encountered was the flannelmouth sucker (n = 235), followed by Colorado pikeminnow (n = 70), razorback sucker (n = 33), bluehead sucker (n = 18), and roundtail chub (n = 5). Overall, the ratio of northern pike to Colorado pikeminnow encountered was greater than 3:1.

All northern pike (except one) and Colorado pikeminnow sampled were greater than 350 mm TL. Northern pike averaged 612 mm and Colorado pikeminnow averaged 532 mm TL. Length-frequency distribution of northern pike removed in 2001 differed from data obtained from the basin-wide razorback sucker monitoring conducted in 1999. The length-frequency distribution was wider for northern pike in 1999 and included a greater abundance of large pike over 600 mm TL in addition to a group of smaller fish between 400 and 475 mm TL. This shift may be a reflection of removal efforts that took place in conjunction with abundance estimates of Colorado pikeminnow during the 2000 field season.

In conclusion, northern pike were vulnerable to removal in the middle Green River during the early spring. A total of 251 northern pike was removed. Highest catch rates were experienced in the Jensen reach. Efficiency of removal efforts will be better determined following subsequent years of control. Setting fyke nets in large backwaters and tributary mouths is the most cost effective removal method for northern pike in the middle Green River. Electrofishing in known concentration areas is also an efficient method. Continued removal of northern pike from concentration areas using a combination of fyke nets and electrofishing is necessary to identify the means and levels of control necessary to minimize the threat of predation and competition on endangered and other native fishes. Development of evaluation indices will allow an assessment of control efficiency and level of control necessary to minimize predatory and competitive impacts to endangered and other native fish species in the middle Green River.

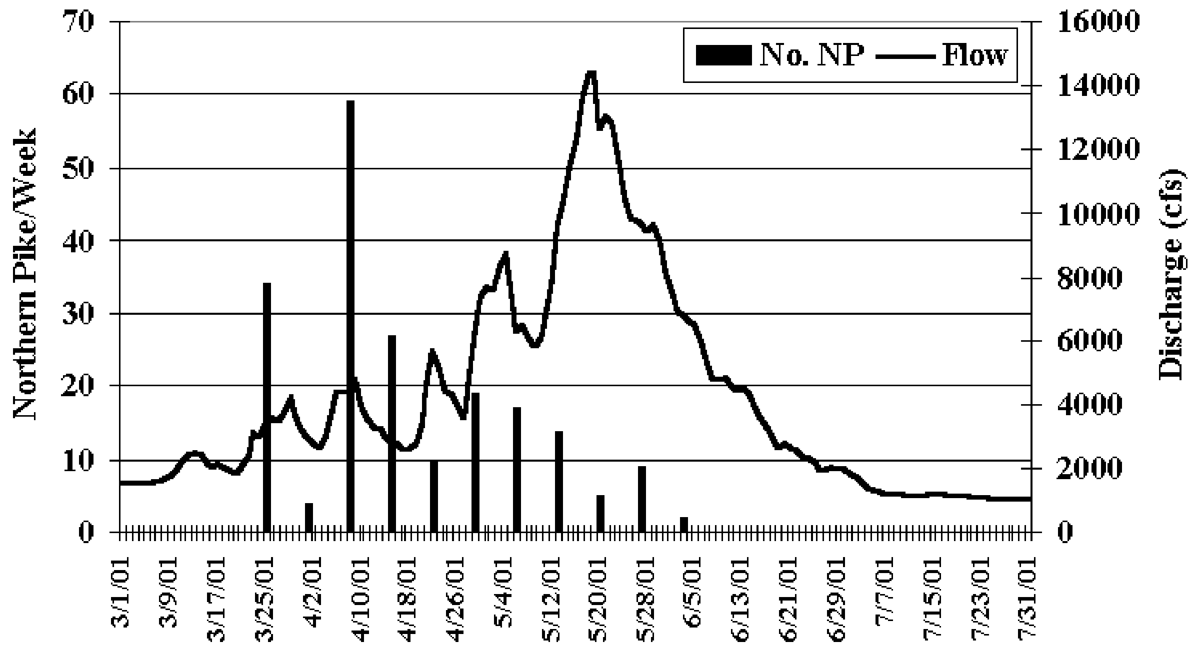


Figure 30. Numbers of northern pike captured per week relative to discharge in the Middle Green River, 2001 (stream gage: Green River near Jensen, Utah).

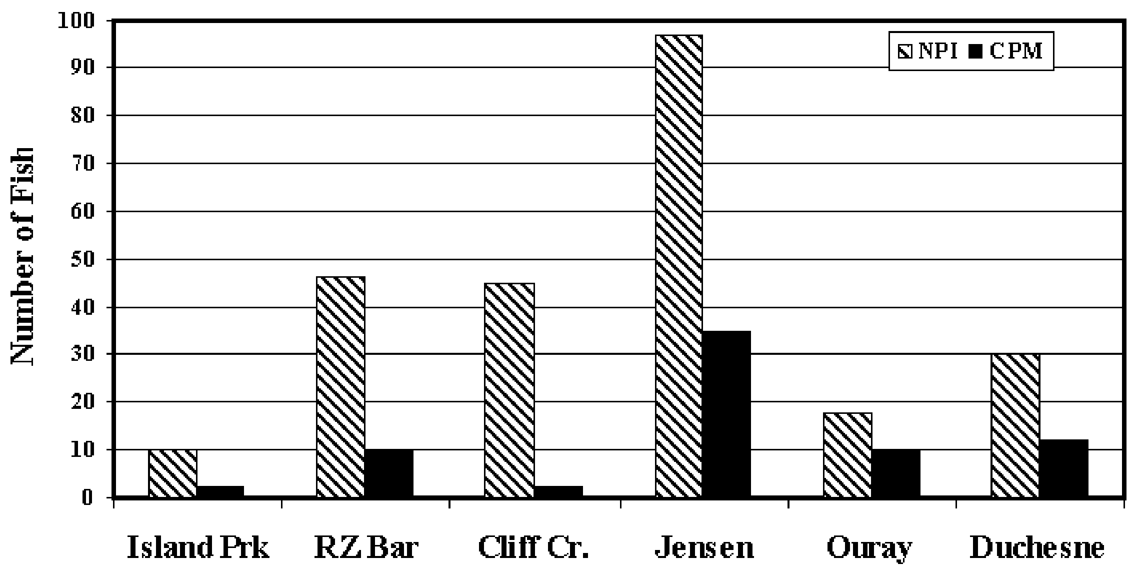


Figure 31. Numbers (and ratios) of northern pike and Colorado pikeminnow captured at six locations of the Middle Green River, 2001.

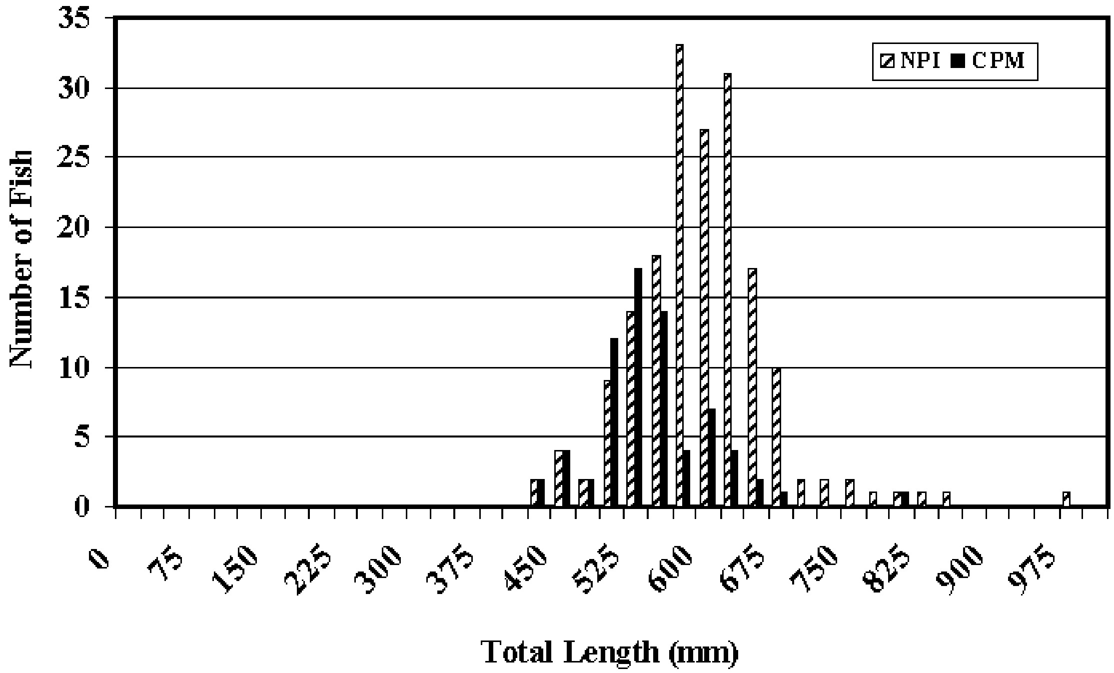


Figure 32. Length-frequency histogram for northern pike and Colorado pikeminnow captured in the Middle Green River, 2001.

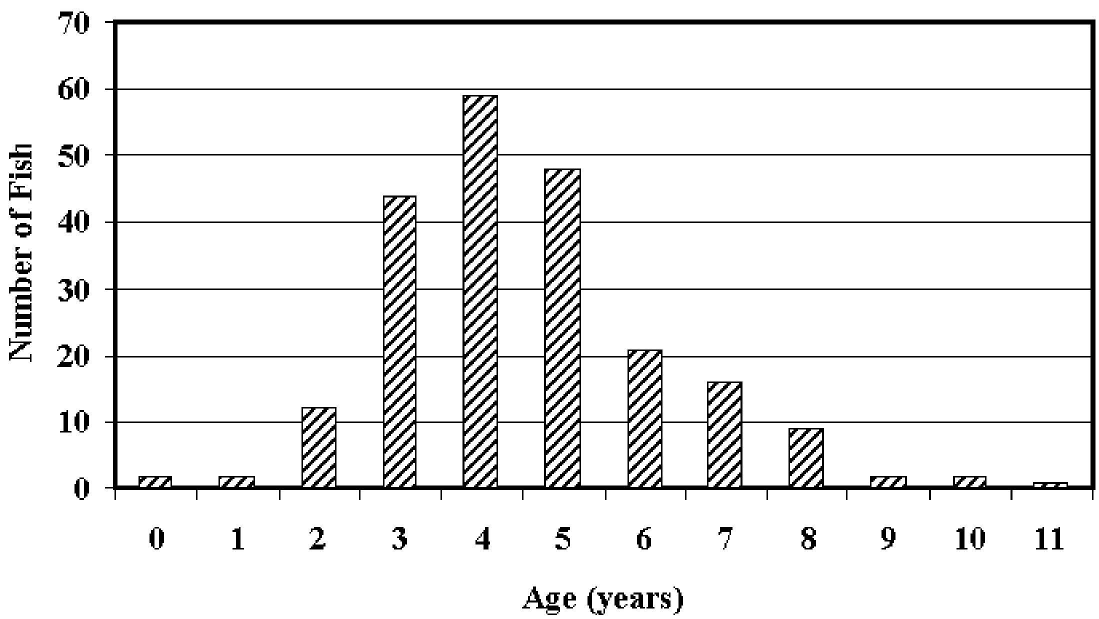


Figure 33. Age distribution for northern pike captured in the Middle Green River, 2001.

Table 12. Effort and efficiency of sampling for northern pike in the Middle Green River, Utah, 2001.

Gear	Samples	Total Hours	Man-Hours	Northern Pike	Pike/Hour	Pike/ Man-Hour
Electrofishing (nonnative control)	26	33	98	55	1.67	0.56
Electrofishing (CPM population estimate)	40	253	759	54	0.21	0.07
Electrofishing Total	66	286	857	109	0.83	0.13
Electrofishing Trammel (block & shock)	17	30	89	22	0.73	0.25
Trammel Net	12	13	4	1	0.08	0.25
Fyke Net	208	10,112	208	119	0.01	0.57
Total	275	10,295	1,158	251	0.02	0.23

3.6 Centrarchid Removal

3.6.1 Electrofishing Removal of Non-Native Fish From Nursery Habitats in the Upper Colorado River (Project No. 89; USFWS-Grand Junction)

During 1999–2000, a nonnative fish control project was conducted on the Upper Colorado River near Grand Junction, Colorado, that focused primarily on the removal of centrarchid species (Figure 34). Two electrofishing passes were made annually through the upper reach of the Colorado River, targeting all backwaters that might harbor nonnative fish. Each year, one pass was made in the spring (March–May) and one pass was made in the fall (August–October). Two electrofishing methods were employed in each pass. An electrofishing boat was used to capture fish in all backwaters deep enough to allow navigation of a boat, and a small walk-behind, fiberglass, electrofishing barge was used in backwaters inaccessible by boat.

The barge proved more effective at capturing centrarchids than the boat because it allowed access to shallow-water areas and backwaters partially isolated from the channel (Figures 35 and 36). These habitats contained pond-like conditions favored by sunfishes. Also, the handheld probes allowed netters to most effectively shock mesohabitats associated with structure (e.g., branches, beaver lodges, rip-rap blocks, root-wads). The boat was primarily effective at removing adult carp.

During the 3-year effort, a total of 3,900 largemouth bass and over 10,000 green sunfish were removed (Table 13). Other sunfishes included black crappie (28), smallmouth bass (14), and bluegill (627). Other nonnatives removed included 2,900 black bullhead, 3,200 white sucker, 100 channel catfish, and over 6,400 common carp. Only one native Colorado pikeminnow was captured. Most largemouth bass captured were 75–250 mm TL (Figure 37).

Based on numbers of fish caught each period, no depletion effective was noted for any species during the 3-year effort. Based on a crude catch-per-effort statistic (average number of fish caught per backwater), catch rates of green sunfish declined while largemouth bass catch rates were variable. ISMP monitoring showed a large increase in largemouth bass densities in backwaters from 1995 to 1998 and a spike in green sunfish densities in 1998 (Figures 38 and 39). Densities of both species declined in 1999 and 2000, but it is unknown if this project, a previous removal project in 1997 and 1998 (Bundy and Bestgen 2001), or the off-channel pond renovation efforts of the Colorado Division of Wildlife contributed to these declines.

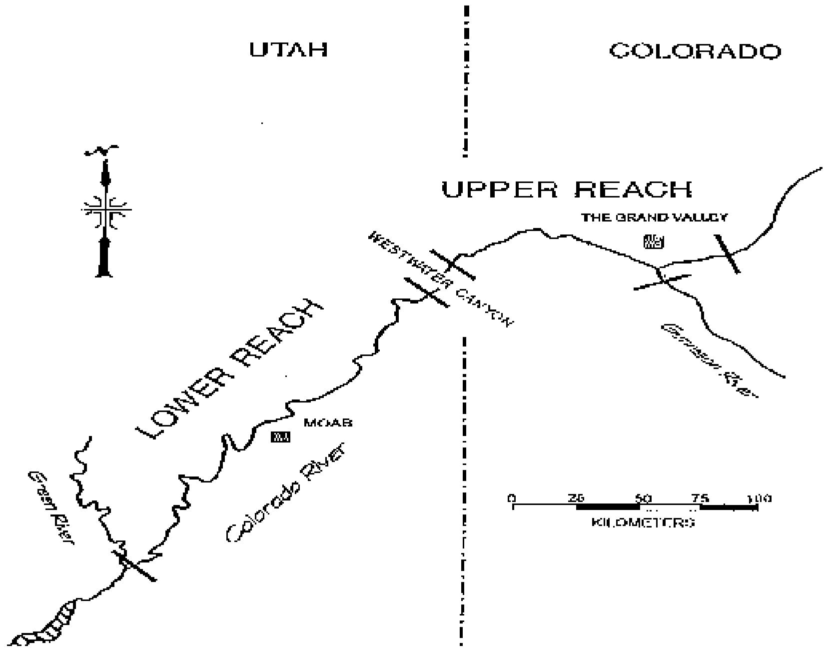


Figure 34. Study area for centrarchid removal from backwaters of the Upper Colorado River.

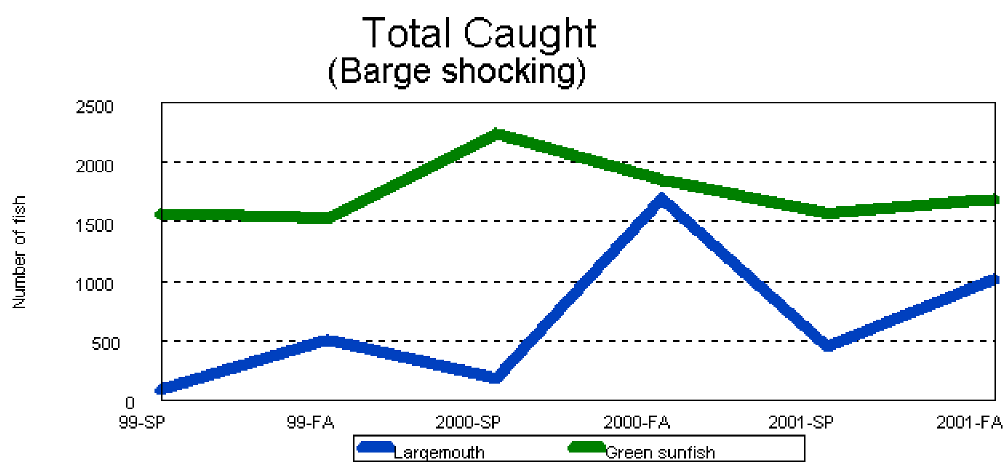


Figure 35. Total numbers of largemouth bass and green sunfish captured from spring of 1999 to fall of 2001.

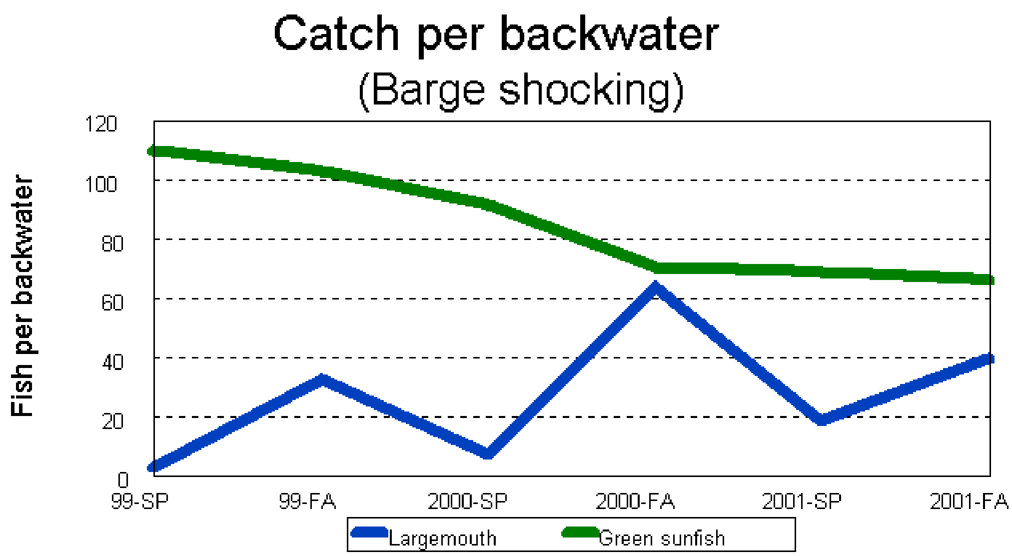


Figure 36. Numbers of largemouth bass and green sunfish captured per backwater from spring of 1999 to fall of 2001.

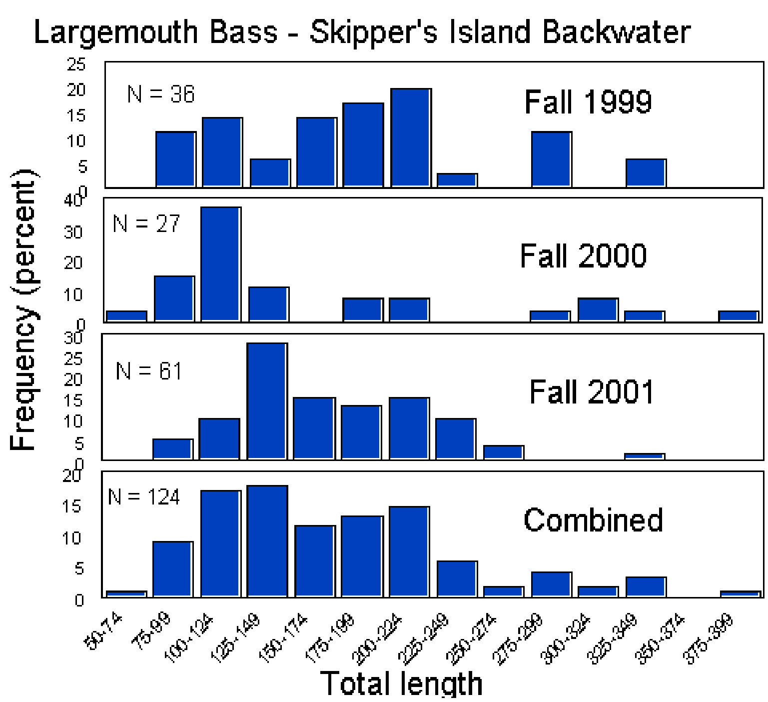


Figure 37. Length-frequency histogram of largemouth bass from Skipper's Island Backwater for fall of 1999, 2000, and 2001, and combined.

Table 13. Numbers of fish removed from backwaters of the Upper Colorado River, 1999–2001.

Species	1999		2000		2001		Total
	Spring	Fall	Spring	Fall	Spring	Fall	
black bullhead	124	132	881	359	579	844	2,919
black crappie	4	3	1	7	3	10	28
bluegill	2	128	92	101	103	201	627
channel catfish	13	0	20	42	13	13	101
common carp	548	549	1354	1771	646	1619	6487
green sunfish	1563	1515	2226	1836	1561	1683	10384
largemouth bass	77	503	172	1700	439	1009	3900
smallmouth bass	1	1	3	3	6	0	14
white sucker	278	328	906	302	661	736	3211
northern pike	0	1	3	0	0	0	4

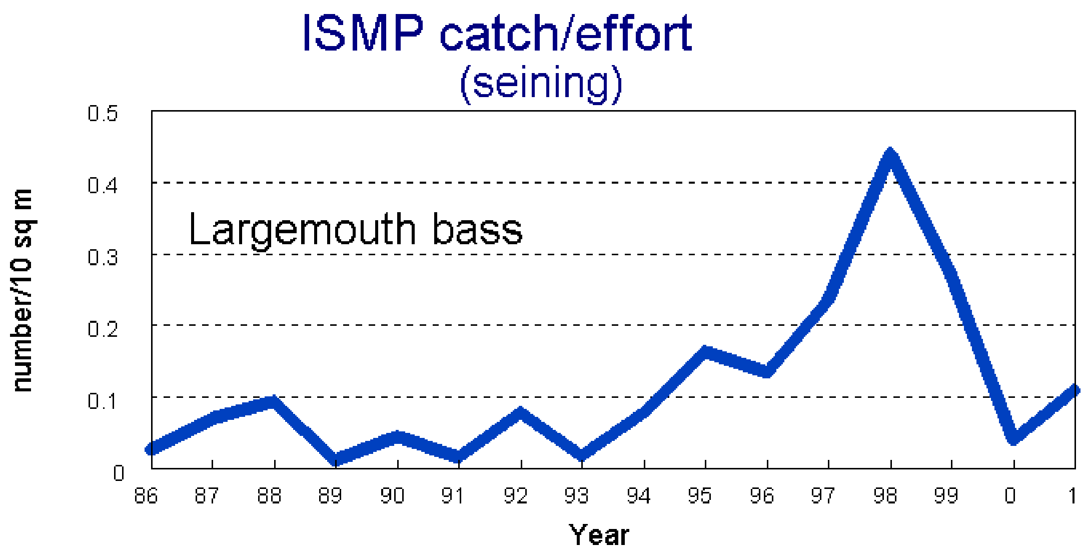


Figure 38. Catch rate of largemouth bass from the Interagency Standardized Monitoring Program (ISMP), 1986–2001.

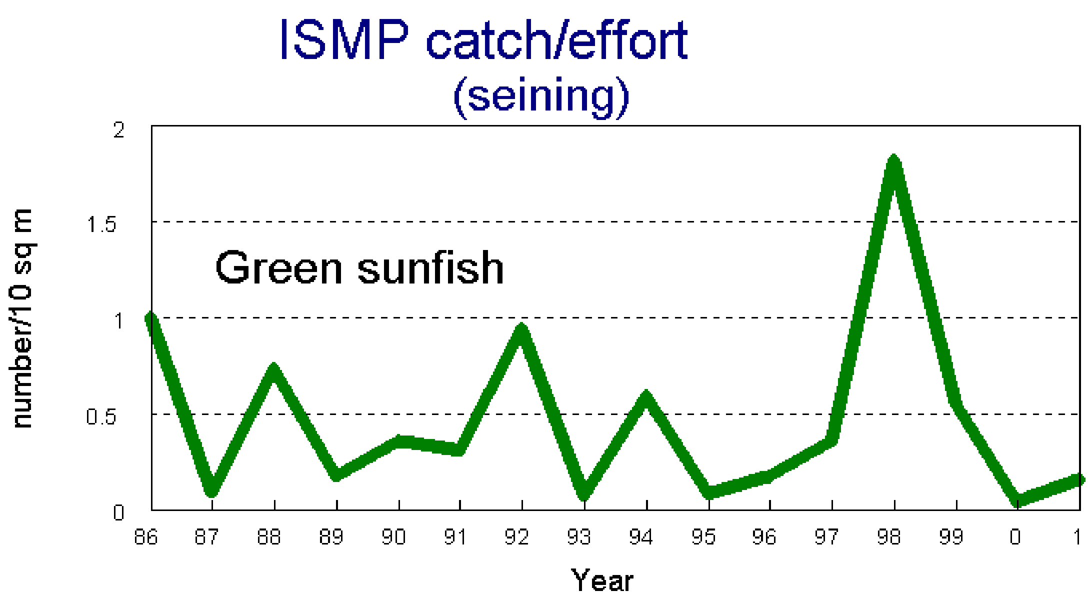


Figure 39. Catch rate of green sunfish from the Interagency Standardized Monitoring Program (ISMP), 1986–2001.

3.6.2 Fish Community Population Estimates on the Upper Colorado River (CDOW)

Density estimates for fish over 15 cm total length were made by mark and recapture sampling in the 15-mile reach (i.e., Colorado River from Palisade, Colorado to Gunnison River confluence) in 1999, 2000, and 2001 (Figure 40). The station in 1999 was from Corn Lake downstream about 2.5 miles. This site was redone the two following years along with the Clifton site, which is about 2.6 miles upstream of Corn Lake. The Clifton site is from RM 180.3 to 177.7. The Corn Lake site is from RM 177.4 to 174.9. Density estimates made with combining recaptures for both sites (5.1 miles in length) were fairly similar between 2000 and 2001 (Table 14). Estimated numbers of fish per kilometer were: 1,200 bluehead sucker; 1,600 flannelmouth sucker; 275 roundtail chub; 550 carp; 500 channel catfish; and 330 white sucker. These data suggest that there are about 13,000 carp in the 15-mile reach.

Results from electrofishing for the 3 years for five backwaters were summarized. High numbers of age I roundtail chub (100–150 mm TL) were found on two occasions in backwaters, but in different locations. In 1999, sunfish were not removed from backwaters, but were removed in 2000 and 2001. Despite removal, green sunfish were more common in 2000 and 2001 than in 1999. This could have been due to better habitat conditions associated with lower summer flows, such as warmer temperature, and higher habitat availability. Removal of sunfish by electrofishing did not appear to be highly effective since the numbers of green sunfish and largemouth bass did not decline as a result of the four and five passes.

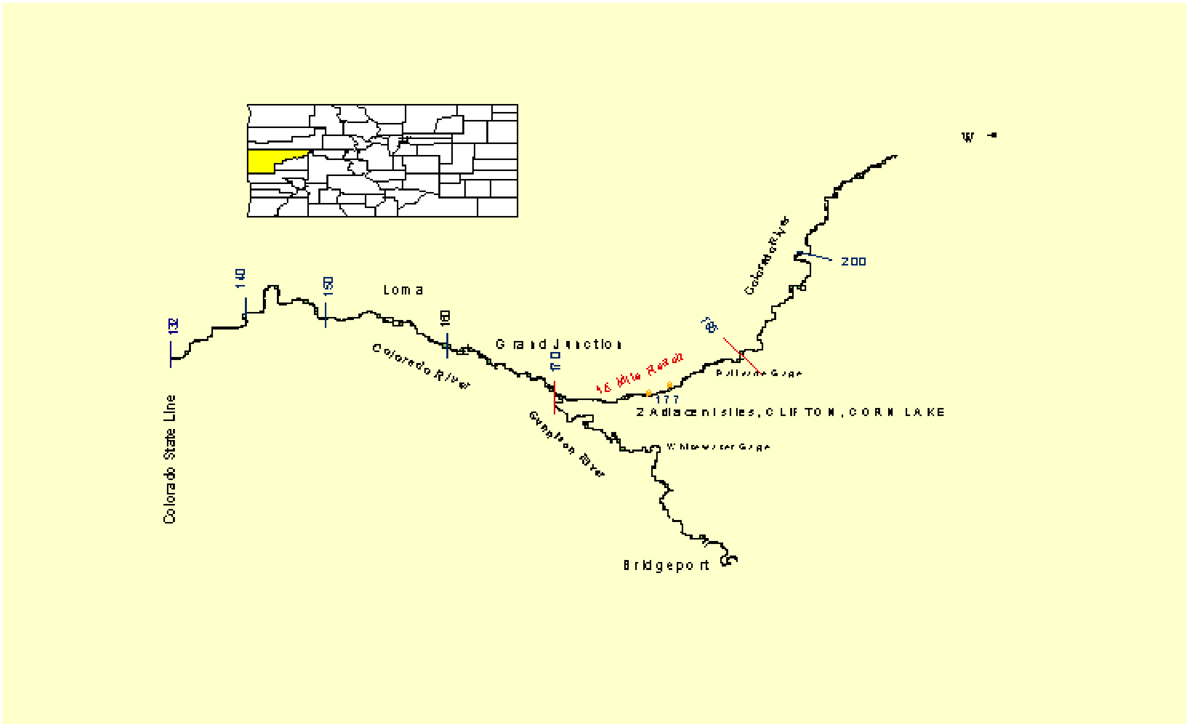


Figure 40. Study areas for population estimates of the fish community in the Upper Colorado River.

Table 14. Density estimates for an 8.4-mile subreach of the 15-mile reach of the Upper Colorado River.

Species	2000	2001
bluehead sucker	1,600	1,261
flannelmouth sucker	1,370	1,664
roundtail chub	402	274
common carp	585	523
channel catfish	401	503
white sucker	164	330

3.7 Channel Catfish Removal

3.7.1 Non-Native Fish Removal Efforts in the Middle and Lower Green River (Project No. 59; UDWR-Moab)

Nonnative fish removal efforts within the middle Green River began in August 1997 and were completed in October 1998. Similar removal efforts were conducted from July 1997 to October 1998 in the lower Green River. Channel catfish and centrarchids were the primary focus of removal efforts. The goal of this project was to implement fish control that effectively reduced negative interactions between nonnative fish and native fish in the Green River, Utah.

Twenty river miles of the middle Green River and 10 river miles of the lower Green River were designated as removal reaches. The middle Green River reach began at the confluence of the Duchesne River and continued downstream. The lower Green River reach began at river mile 142 in Gray Canyon and continued downstream to river mile 132. Baited fyke nets and shoreline electrofishing were the two methods employed to capture the target species. A total of 15,695 fyke net hours and 52 hours of electrofishing were expended in the middle Green River. In the lower Green River, sample effort included 7,019 fyke net hours and 41 hours of electrofishing.

A total of 35,311 nonnative fish were removed by both fyke netting and electrofishing during 1997 and 1998 in the middle Green River (Figure 41). Ninety percent of nonnative fish captured were channel catfish, comprising 61% of total fish biomass captured. Smallmouth bass comprised 1% of the total nonnative fish catch and 4.4% of the total fish community. In the middle Green River, electrofishing was found to be the most effective method for capturing centrarchids. Centrarchids had the second highest catch rates, following channel catfish during 1997 electrofishing. Channel catfish catch rates were highest during the September trips for both fyke netting and electrofishing in both years of sampling. Smallmouth bass catch rates increased steadily throughout the sampling season in 1997 and were highest in August 1998. Baited fyke nets primarily collected small channel catfish. Small channel catfish catch rates collected in fyke nets significantly dropped between the two sampling years.

During 1997 and 1998, a total of 9,463 nonnative fish were removed from the lower Green River by fyke netting and electrofishing (Figure 41). Approximately 96% of nonnative fish captured were channel catfish which comprised 84% of total fish captured. Ninety-seven percent of all fyke net catches were channel catfish. As in the middle Green River, fyke nets collected primarily small channel catfish (Figure 42). Large channel catfish were most abundant during the October electrofishing trip. In the lower Green River, smallmouth bass were not present and channel catfish were the most common species captured by electrofishing (76%). Flannelmouth sucker were the second most abundant fish captured after channel catfish during electrofishing. During 1998, catch rates of medium and large channel catfish increased between trips, and catch rates for medium and all sizes of channel catfish significantly increased between years.

While electrofishing tends to collect a wider range of sizes, the small size class of channel catfish were the most abundant collected during sampling for this project (Figure 43). This indicates

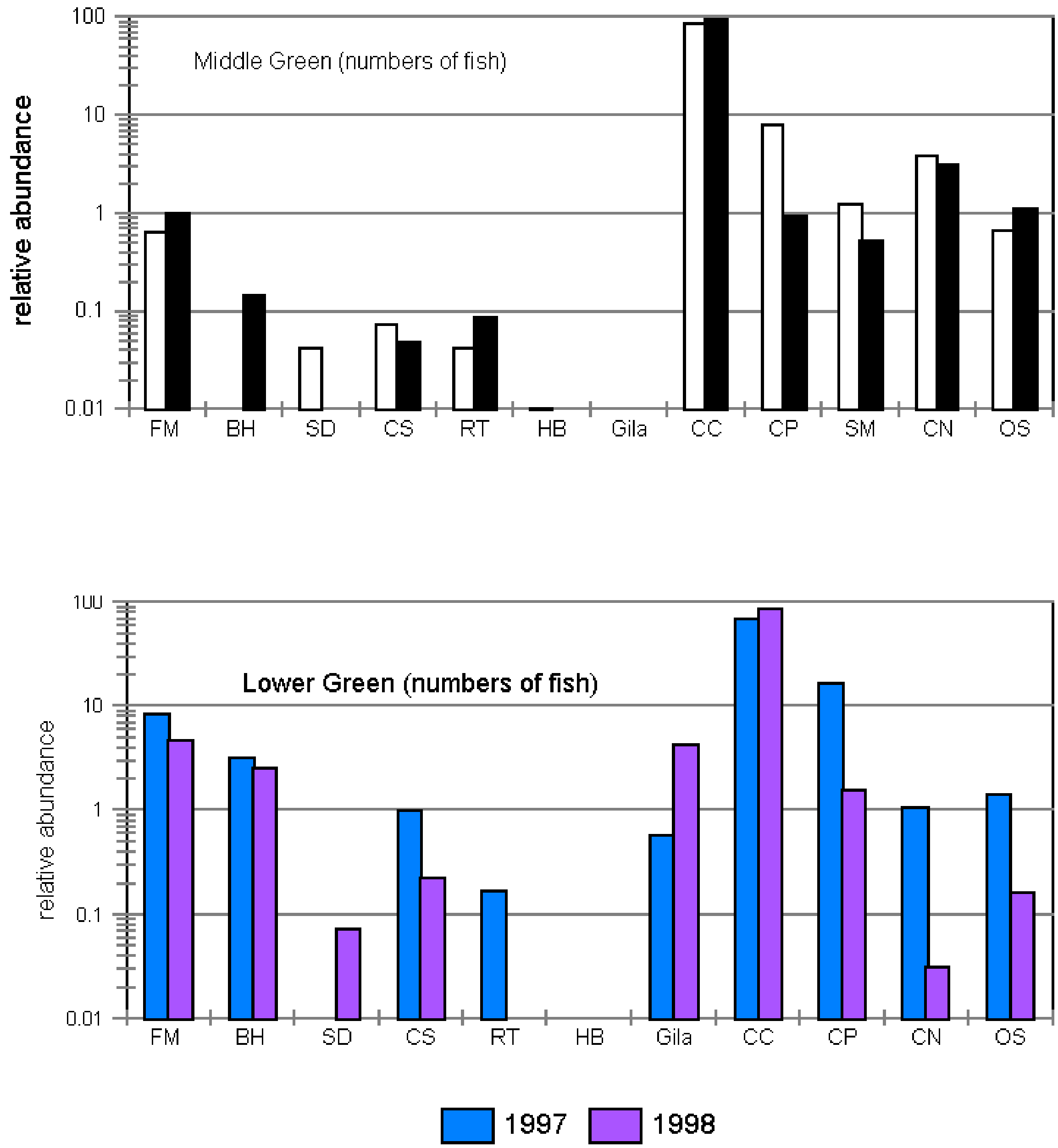
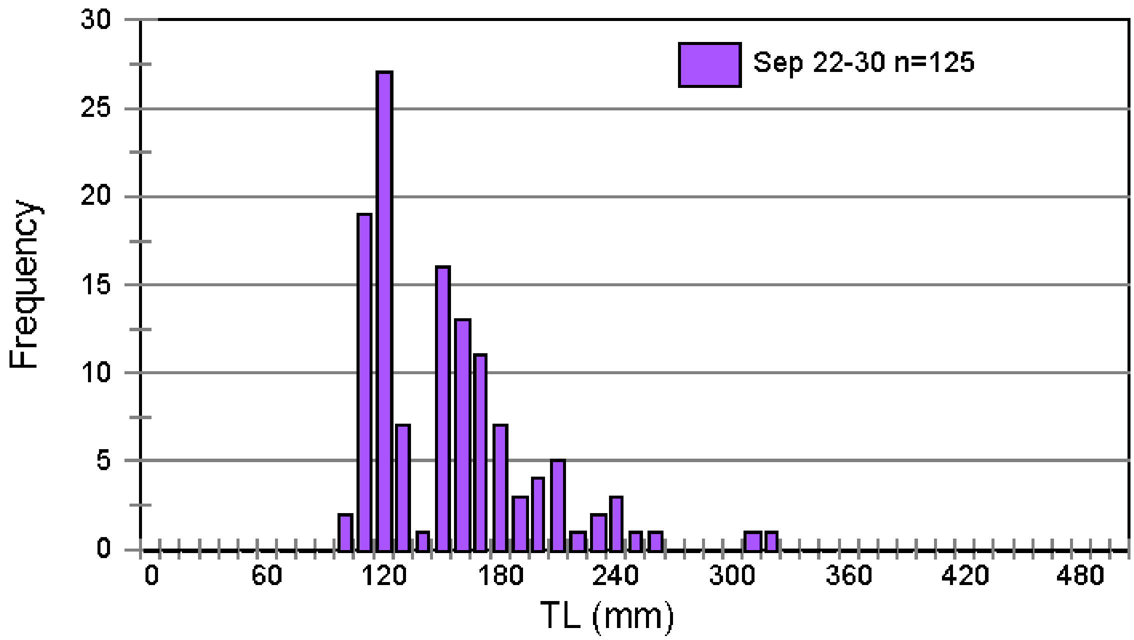


Figure 41. Relative abundance of fishes in the Middle Green River and Lower Green River, 1997 and 1998.



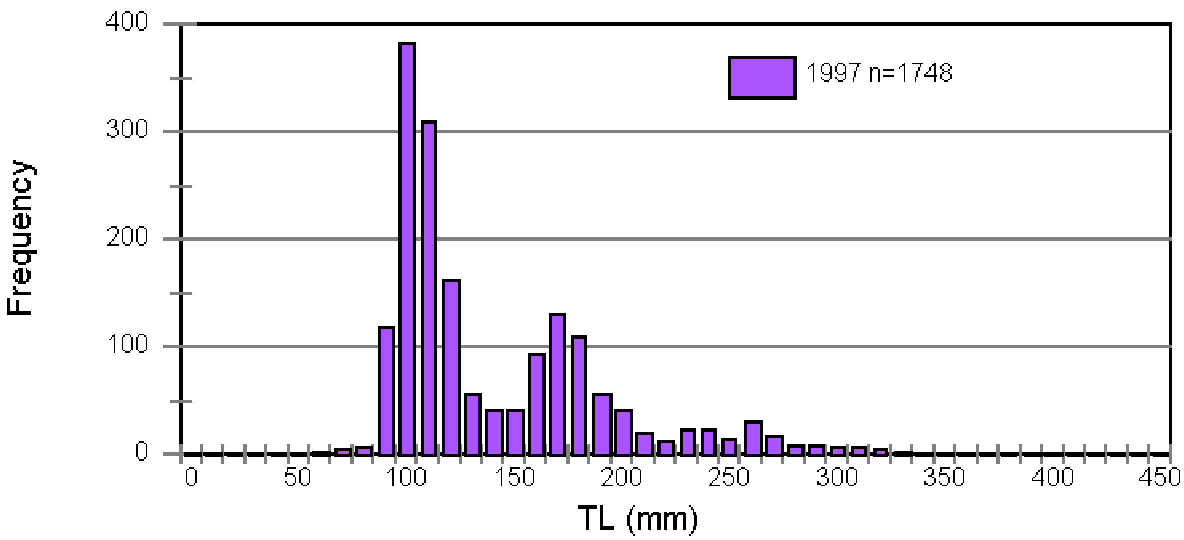
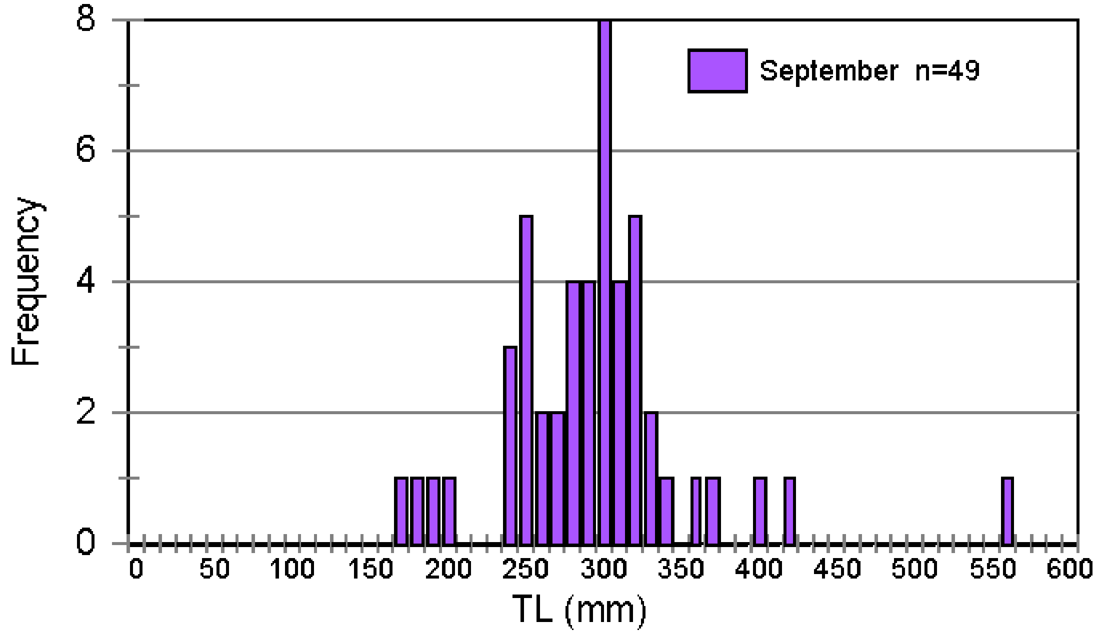


Figure 42. Length-frequency distribution for channel catfish captured in fyke nets in the Middle Green River in 1998 (top) and in the Lower Green River in 1997 (bottom).



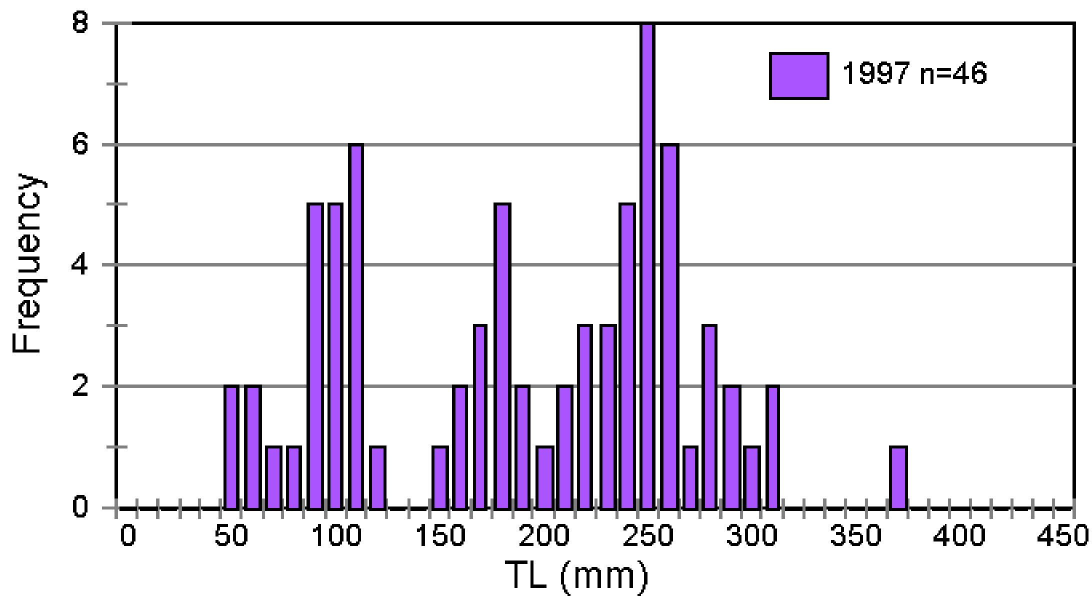


Figure 43. Length-frequency distribution for channel catfish captured with electrofishing in the Middle Green River in 1998 (top) and in the Lower Green River in 1997 (bottom).

that the middle and lower Green River may provide nursery habitats for the smaller immature channel catfish. Thus, the methods employed during this project were specifically designed and refined to target small channel catfish.

The study concluded that:

- fyke nets proved to be an effective method in removing channel catfish in the middle and lower Green River;
- electrofishing tended to be more effective at collecting centrarchids and adult channel catfish;
- immature channel catfish are the most abundant age class in the middle and lower Green River; and
- channel catfish and smallmouth bass catch rates were highest during the late summer and early fall months.

The study recommended that:

- if smallmouth bass and other centrarchids are to be the focus of depletion efforts in the middle and lower Green River, electrofishing should be the primary method of removal;
- if small channel catfish are to be the target of depletion efforts in the middle and lower Green River, fyke nets should be the primary method of removal, with additional electrofishing to determine overall size structure of the population; and
- any future channel catfish or centrarchid removal in the middle and/or lower Green River should be conducted in late summer and early fall, specifically August and September.

3.7.2 Development of a Channel Catfish Control Program in the Lower Yampa River Within Yampa Canyon (Project No. 110; USFWS-Vernal)

Channel catfish are the most abundant non-native predator in the Yampa River (Fuller and Modde 2001). They compete with endangered and native fishes for food, space and habitat (Hawkins and Nesler 1991; Tyus and Saunders 1996). Channel catfish negatively impact all life stages of humpback chub Tyus and Saunders 1996), and they play a major role in the decline in humpback chub Tyus 1998).

In 1998 a channel catfish reduction study was initiated in portions of the lower Yampa (Canyon) River, in Dinosaur National Monument (Figure 44). A larger scale removal effort was initiated in 2000 to remove channel catfish from the entire canyon. The objectives of the study were to:

- reduce the abundance of adult channel catfish in Yampa Canyon by capture and removal;
- determine the most effective method of reducing channel catfish; and
- determine fish community responses to reductions in channel catfish population size, including channel catfish reproduction and recruitment.

Ten removal reaches were established between river kilometer (KM) 72 and 0 (confluence of Green River). Three electrofishing passes were conducted on each reach, and two angling passes were conducted on each of four trips. Also, four monitoring reaches were established, each one river mile in length. Two electrofishing passes were conducted on each monitoring reach.

The results of the initial study identified the most effective removal methods as angling and electroshocking. The highest catch rate of channel catfish occurred with electroshocking, although the greatest number of fish were removed by angling (Figures 45, 46, and 47). Electroshocking and angling methods complimented each other well. Electrofishing effectively sampled shallow higher velocity environments such as runs and riffles, but rafts could not navigate the canyon at flows below approximately 1,000 cfs. Angling was employed as flows receded below 1,000 cfs and was more efficient in deeper slower velocity habitat. The pools were more effectively sampled during low flow conditions with angling and areas of high fish densities could be fished with greater intensity. Results of the initial effort suggested that population densities were not extremely high, as previously thought by investigators. Densities in three of four sample reaches varied between approximately 90 and 200 fish/km (Figure 48).

A length gradient of channel catfish was observed in both Yampa Canyon and the larger tributary-mainstem system (Figure 49). Larger fish tended to occupy the upper reaches of the Yampa River and the size of the smallest fish in the canyon appeared to be between three and four years of age. Shoreline electroshocking and seining in the canyon associated with other studies have failed to detect smaller channel catfish. Thus, it appears that recruitment of channel catfish may be coming from downstream nursery areas and larger, more fecund spawning adults occupy the upstream reaches of the Yampa River above Dinosaur National Monument.

Because Yampa Canyon is effectively sampled and densities fairly low, it appears channel catfish reduction in the lower Yampa River is feasible. Greater effectiveness in channel catfish control may be attained by removing larger adult spawning individuals in the reaches of river above Yampa Canyon.

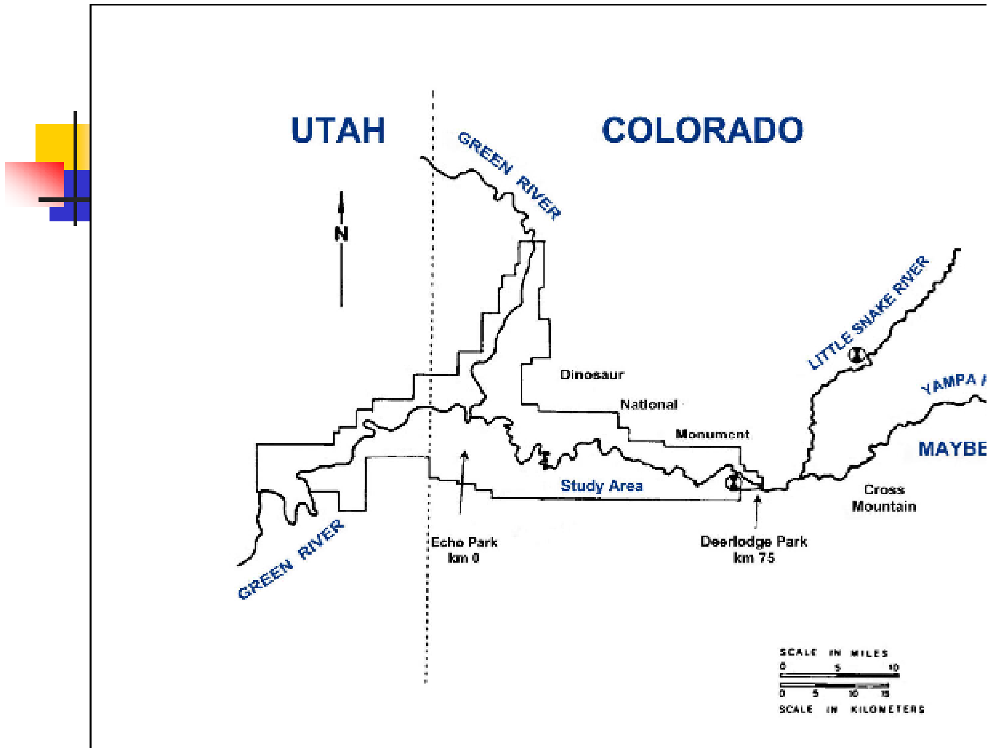


Figure 44. Study area for channel catfish reduction program in the lower Yampa River.

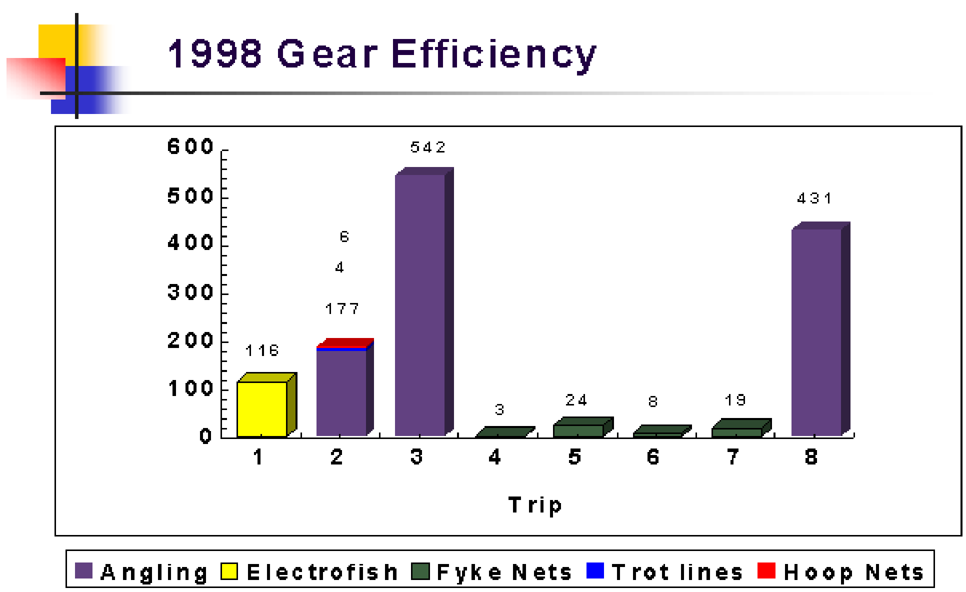


Figure 45. Numbers of channel catfish removed with five gear types in the lower Yampa River.

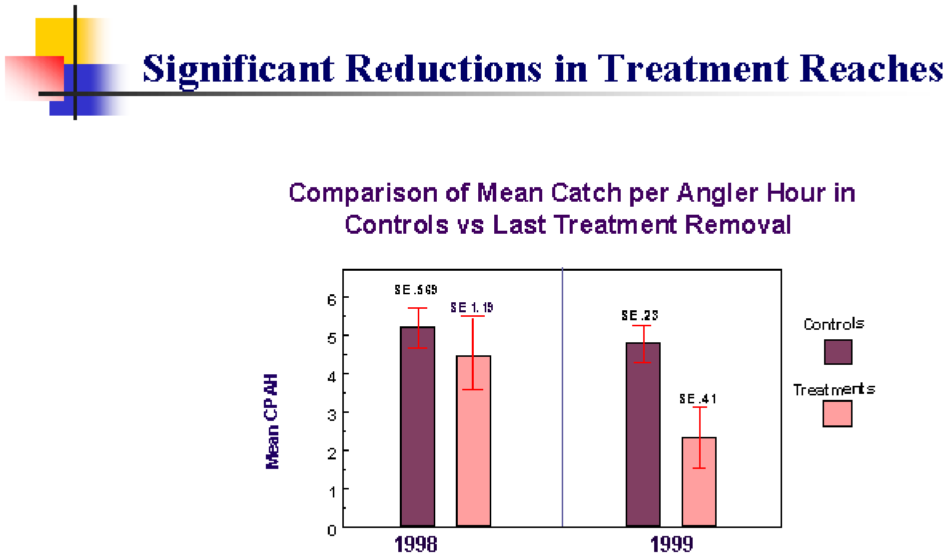


Figure 46. Comparison of mean catch per angler hour in controls vs. last treatment removal in the lower Yampa River.

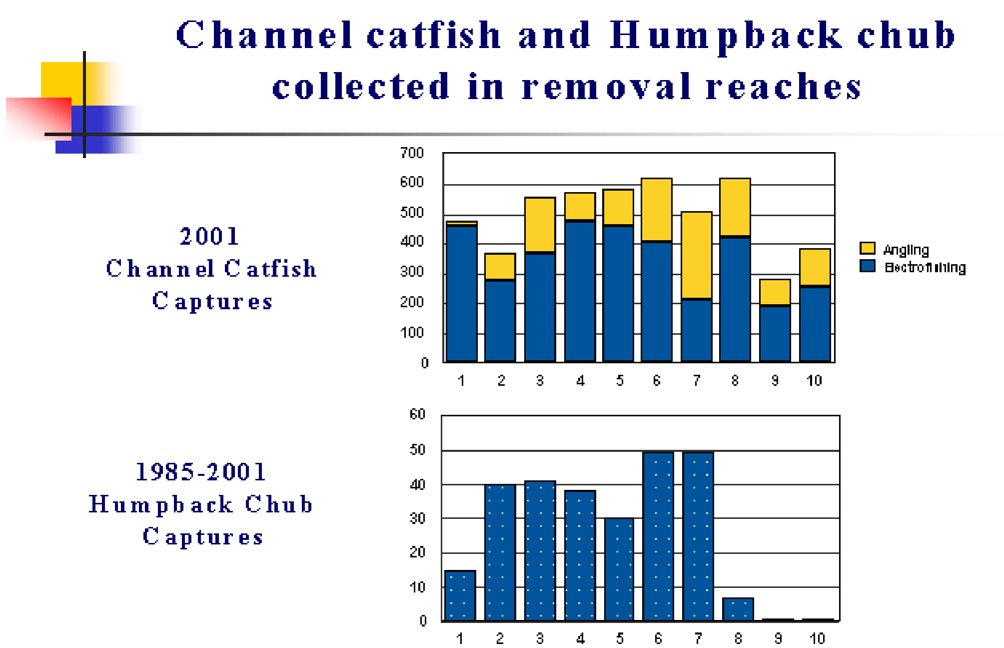


Figure 47. Channel catfish and humpback chub collected in removal reaches in the lower Yampa River.

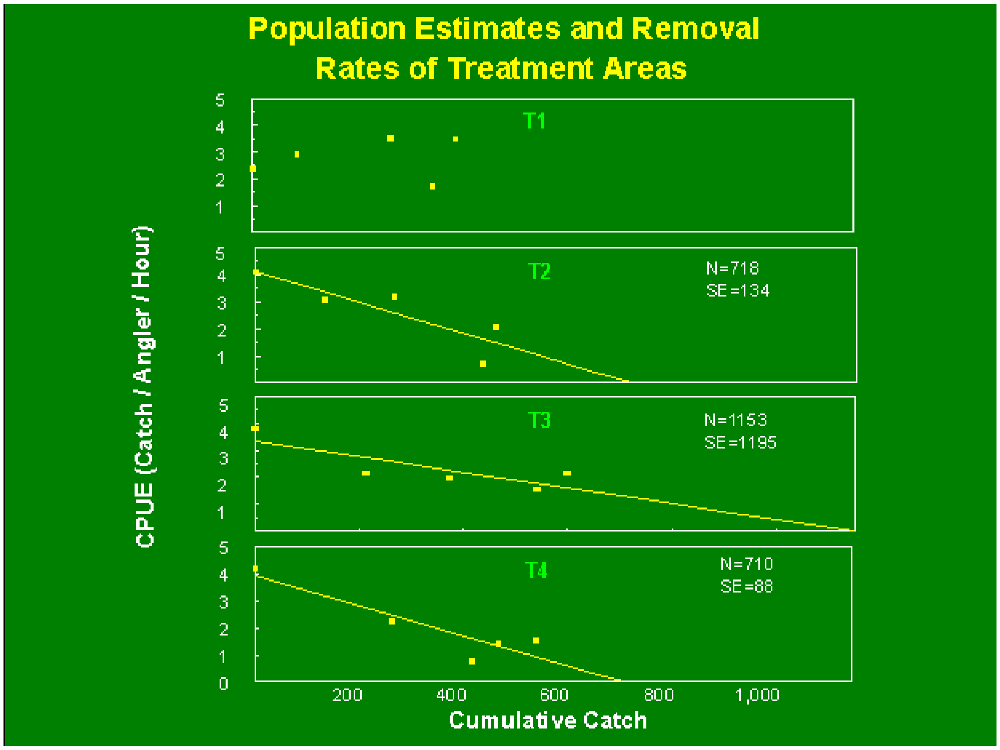


Figure 48. Population estimates of channel catfish and removal rates in treatment areas in the lower Yampa River.

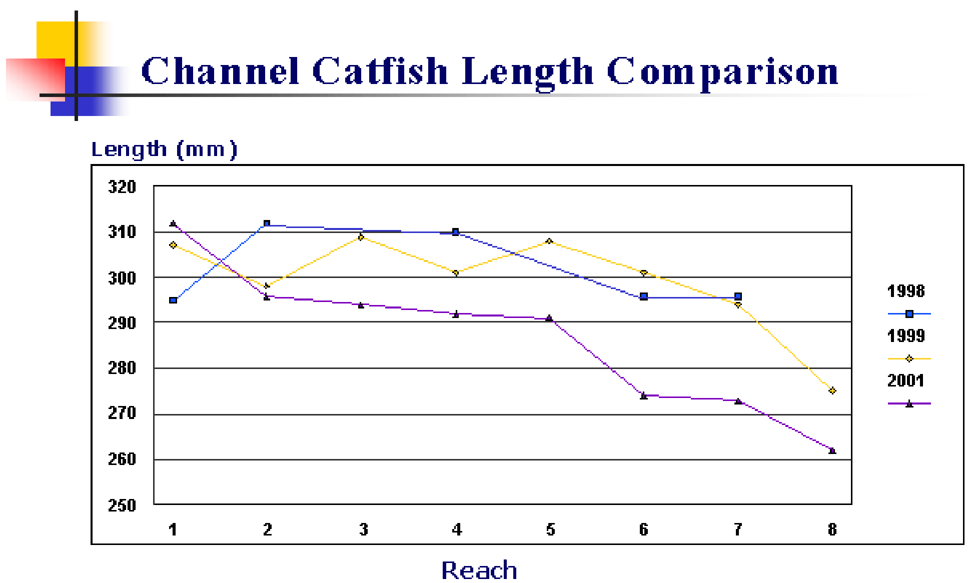


Figure 49. Length comparison for channel catfish for 1998–2001 in the lower Yampa River.

3.7.3 Development of Channel Catfish Control Programs in the Duchesne, White, and Colorado Rivers

Control efforts by the Utah Division of Wildlife Resources (UDWR) on the middle and lower Green River identified concentrations of nonnative fishes at the confluences of the Duchesne River and White River, as well as the Upper Colorado River in Utah (see section 3.7.1). Focused efforts on these inflow areas could effectively reduce nonnatives that concentrate in these inflows and use them as holding areas during runoff, for spawning, as nurseries for young, or for feeding. Timing of control efforts in these areas, especially the inflows will be key to an effective control program, but proper strategy could produce substantial results with minimal effort.

3.8 Small-Bodied Fish Removal

3.8.1 Mechanical Removal of Non-Native Cyprinids in the Lower Green and Colorado Rivers, Utah (Project No. 87a; UDWR-Moab)

Controlling nonnative species of fish in the upper Colorado River basin has been a concern of the Recovery Implementation Program for Endangered Fish Species of the Upper Colorado River (Recovery Program) for many years. Beginning in 1998, the Utah Division of Wildlife Resources (UDWR) was funded to examine the effectiveness and feasibility of removing nonnative cyprinids on the lower Green and Colorado rivers, Utah, for the benefit of native endangered fish larvae. The results of this 3-year study indicate that mechanical removal of nonnative cyprinids from habitats on both rivers may only be effective and realistic on a temporary basis with the appropriate approach or combination of approaches. On the lower Green River, approximately 129,000 nonnative cyprinids were removed over 3 years (Figure 50) compared to 159,000 on the Colorado River during the same period of time (Figures 51 and 52; Table 15). Despite these removal efforts, no correlation could be found between numbers and size of native larvae that could be attributed to removal efforts. Numbers of native fishes captured as a result of these efforts was variable between years, with no pattern that corresponded with removal efforts (Figures 51 and 53).

The conclusions emanating from this project are uncertain, with the exception that mechanical removal via seining may not be effective. Other options must be investigated if nonnative cyprinid numbers are to be controlled. The use of physicochemical means (hydrograph manipulation) may have some role in control, however it too is temporary and possibly detrimental in the long term. Final decisions may include the inability to manage nonnative cyprinid species unless there is a clear negative impact statistically proven.

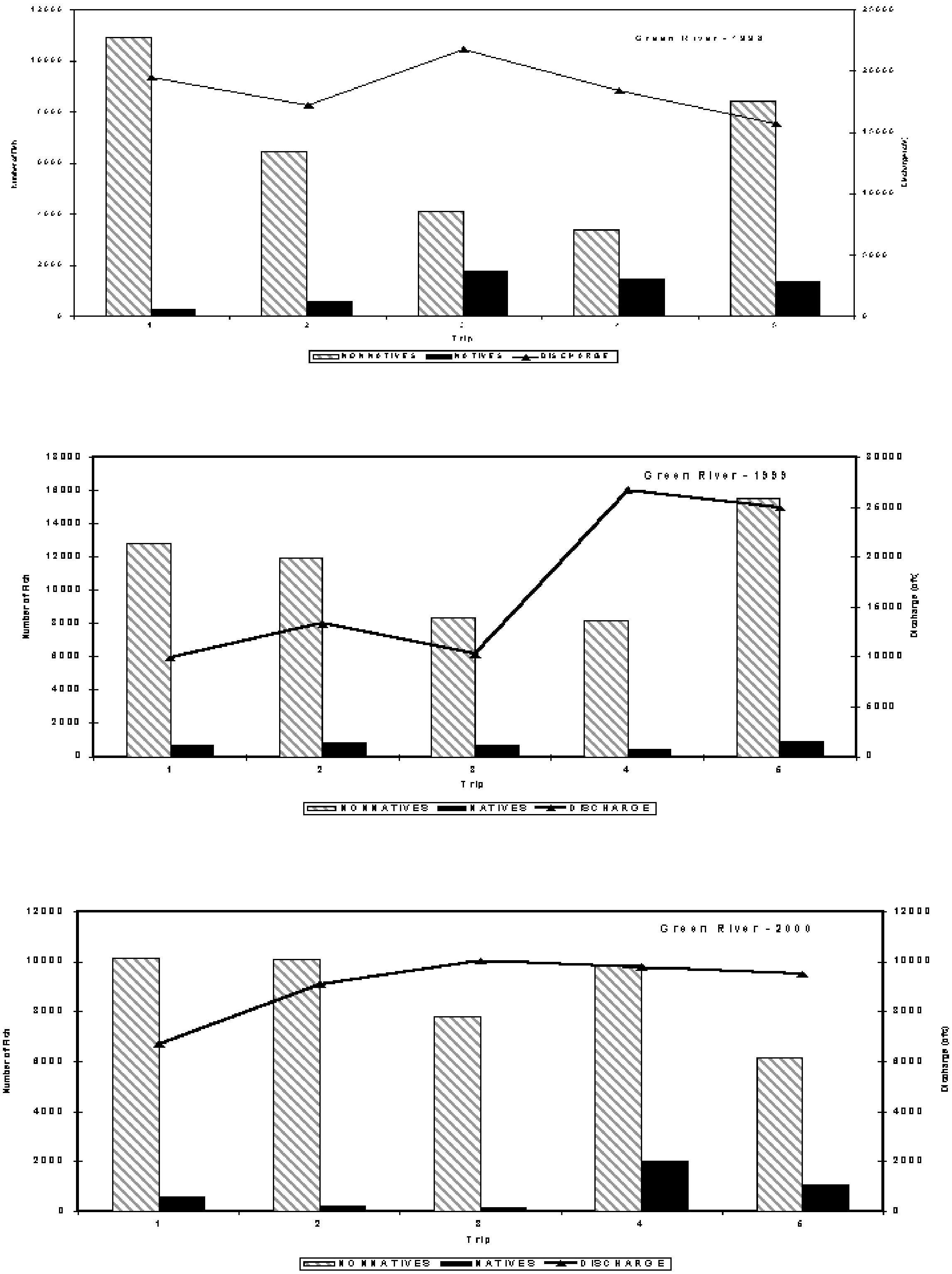


Figure 50. Total numbers of fish captured in the Lower Green River (1998–2000).

Table 15. Numbers of nonnative cyprinids removed from the Lower Green and Upper Colorado rivers (1998–2000).

Lower Green River		Upper Colorado River	
Year	Numbers	Year	Numbers
1998	33,719	1998	13,794
1999	47,978	1999	92,847
2000	47,500	2000	42,000
Total	129,197	Total	148,641

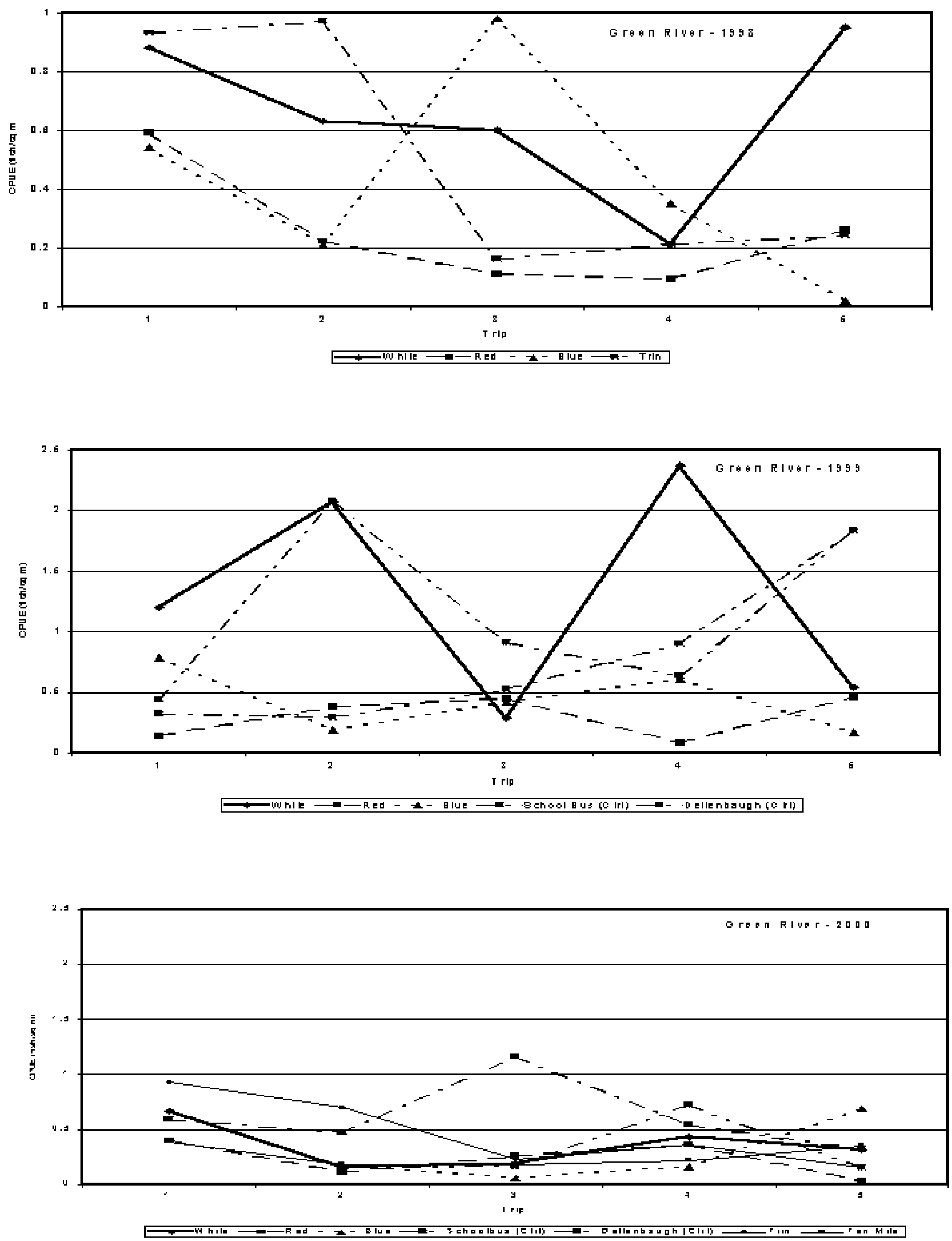


Figure 51. Catch rates for all fish at different sites on the Lower Green River (1998–2000).

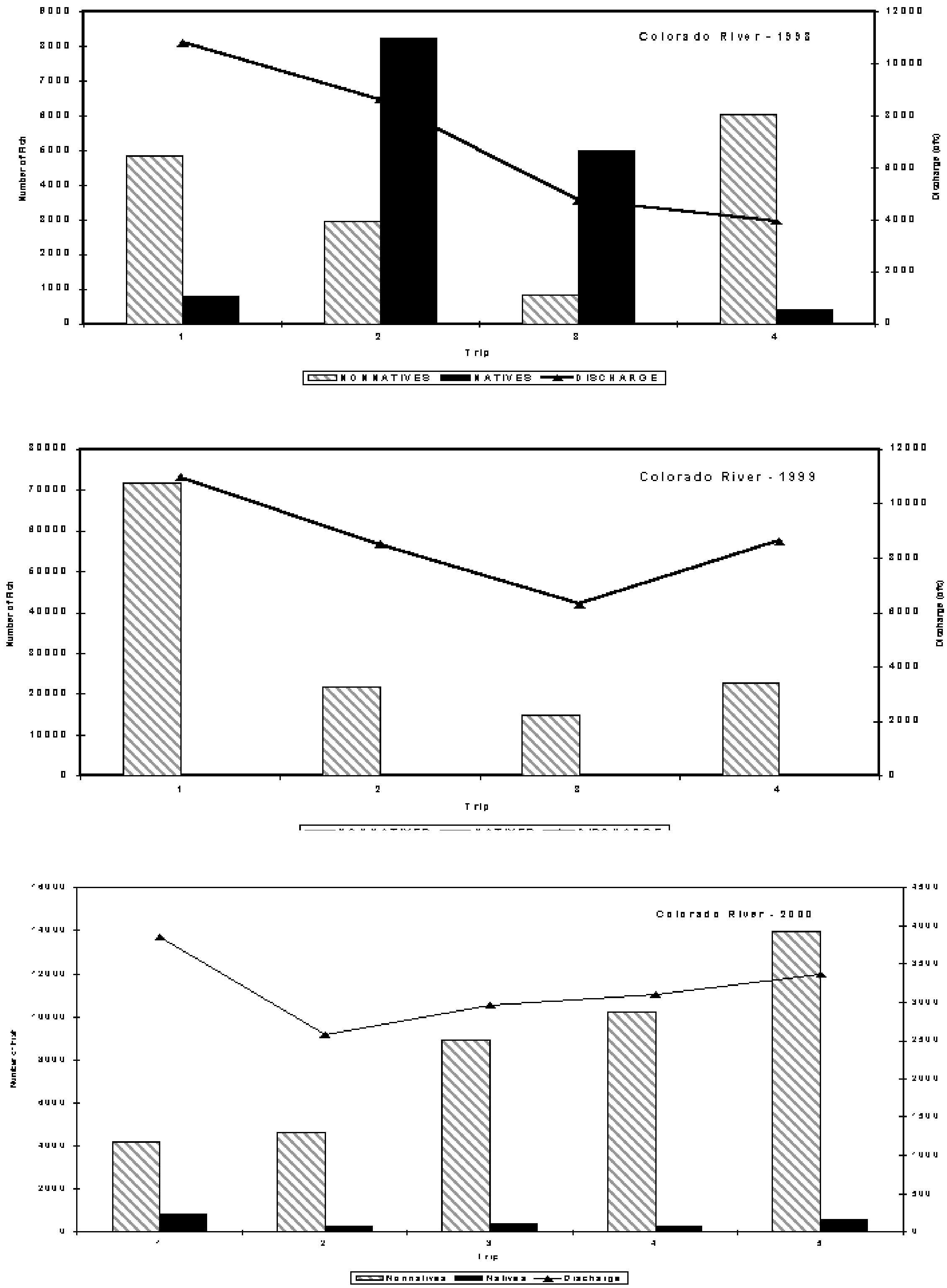


Figure 52. Total numbers of fish captured in the Upper Colorado River (1998–2000).

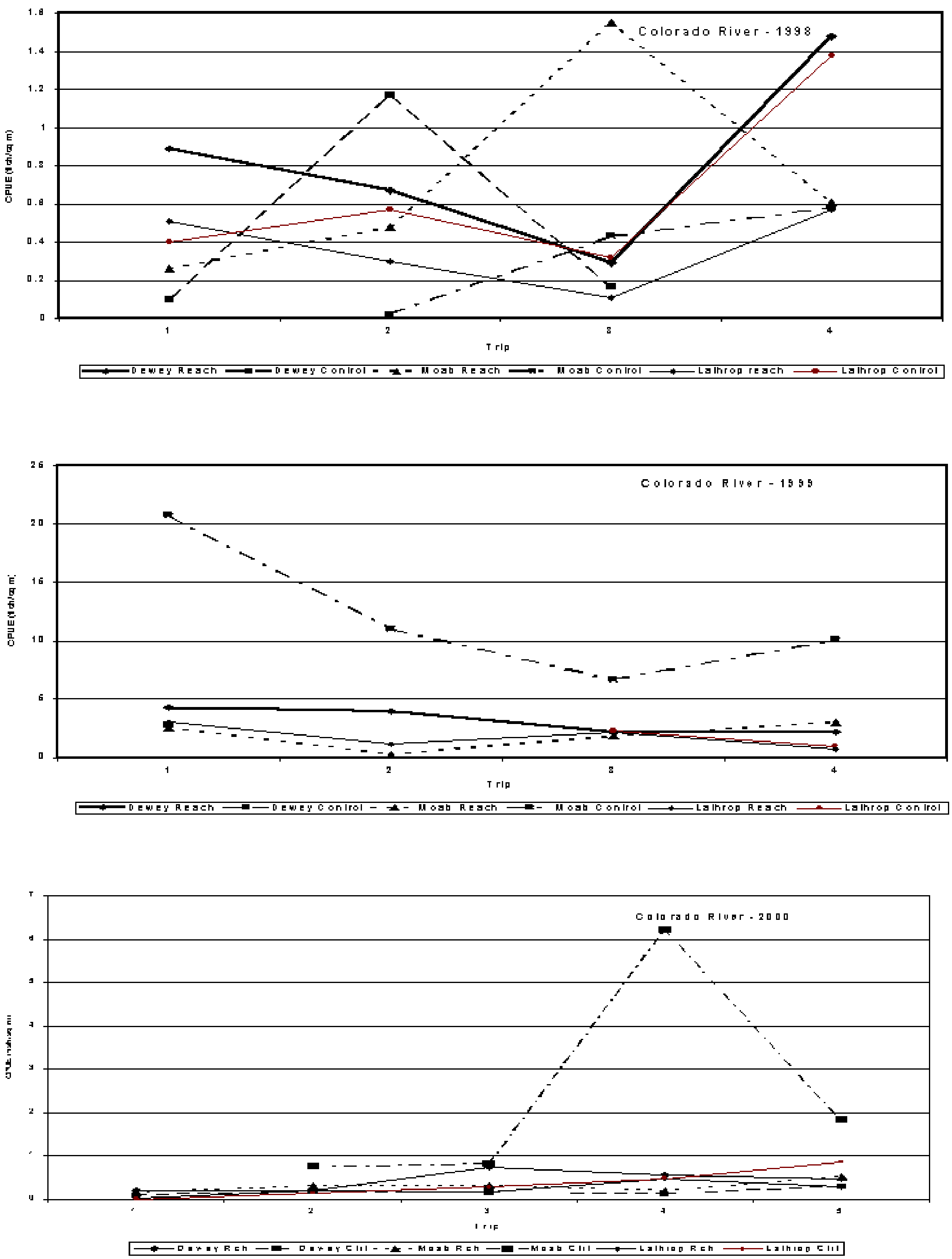


Figure 53. Catch rates for all fish at different sites on the Upper Colorado River (1998–2000).

3.8.2 Non-Native Fish Control in Backwater Habitats in the Colorado River in Colorado (Project No. 87b; CDOW, SWCA Environmental Consultants)

Predation and competition between small, non-native cyprinid species and young endangered fishes has been demonstrated in laboratory experiments (Ruppert et al. 1993; Muth and Beyers, unpublished data), and is perceived to be influential in limiting survival and recruitment of the endangered Colorado pikeminnow and razorback sucker in the wild. The objectives of this study were to:

- significantly reduce the abundance of small, nonnative cyprinid and centrarchid fish species present in backwaters in the Colorado River;
- significantly increase the survival and abundance of native and endangered fish species using backwater habitats;
- evaluate backwater seining as an effective field method for controlling the abundance of small, nonnative cyprinid and centrarchid fish species; and
- induce a positive biological response within the native fish community.

Response to depletion was evaluated using Interagency Standardized Monitoring Program (ISMP) catch data. Depletion sampling was conducted on the Colorado River in the 15- and 18-mile reaches in June–July, 1999; March–April, 2000; and June 2001. Four to five depletion passes were made in each year. Only seine hauls with fewer than 50% native fishes were processed for total fish numbers and weights; fish in hauls with more than 50% native fishes were released (Table 16). The ratio of nonnative to native fishes ranged from 4:1 to 6:1 (Figure 54). Of total fish captured, 6 species were native; 4 were nonnative cyprinids; 4 were nonnative centrarchids; and 4 were other species (Figure 55). In 1999, 9,129 nonnative fish were removed from 65 backwaters. In 2000, 7,081 nonnative fish were removed from 58 backwaters (Table 17). In 2001, 180,379 nonnative fish were removed from 82 backwaters. In addition to nonnative fishes in these backwaters, many also contained numerous bullfrog adults and tadpoles, as well as crayfish (Table 18).

Catch and catch rate of all fish initially declined after the first pass in all reaches and years, but increased by the fourth pass in most cases (Figure 56). Individual backwaters were successfully depleted in 3–5 seine hauls on each sampling occasion, but catch and catch rate of nonnative fishes returned to previous levels by the next sampling occasion 2–4 days later (Figure 57). The effects of depletion by seining were thus temporary, at best. Backwaters were quickly reinvaded by nonnative cyprinids which occur in large numbers in low-velocity habitat along shorelines in the main channel outside of backwaters. Comparison of ISMP fall catch rates prior to and after depletion efforts were inconclusive. Catch rates and relative percentage of native fishes increased from 1998 to 1999, but catch rate of nonnative fishes also increased. Catch and relative percentage of native fishes fell again in 2000, and increased slightly in 2001. Catch rates of both native and nonnative fishes in 1999, 2000 and 2001 ISMP sampling were not significantly different from mean catch rates in 1986 to 1998 (Figure 58). Seining does not appear to be an effective tool for removing nonnative cyprinids from backwater habitats.

Table 16. Number of backwaters sampled in the 15-Mile and 18-Mile reaches with less than or greater than 50% native fish (1999–2001).

Year	Reach	>50% Native	<50% Native	No Fish	Total
1999	15-Mile	16	22	0	38
	18-Mile	5	22	0	27
	Total	21	44	0	65
2000	15-Mile	4	14	11	29
	18-Mile	2	19	8	29
	Total	6	33	19	58
2001	15-Mile	4	31	2	37
	18-Mile	1	44	0	45
	Total	5	75	2	82

Table 17. Number of fish captured and estimated number of fish present in backwaters of the 15-Mile and 18-Mile reaches (1999–2001).

Year	Reach	Native	Nonnative	Total	ML Estimate	Percent Captured	Biomass Removed
1999	15-Mile	1,285	5,434	6,719	16,355	41.1	9,710
	18-Mile	756	3,695	4,451	17,136	25.9	8,147
	Total	2,041	9,129	11,170	33,491	33.4	17,857
2000	15-Mile	189	964	1,153	1,296	88.9	510
	18-Mile	153	6,117	6,270	9,245	67.8	2,771
	Total	342	7,081	7,423	10,541	70.4	3,281
2001	15-Mile	4,416	67,100	71,516	74,661	95.8	34,717
	18-Mile	2,242	113,279	115,521	133,350	86.6	69,110
	Total	6,658	180,379	187,037	208,011	89.9	103,827
Total		9,041	196,589	205,630	252,043	81.5	124,965

Table 18. Numbers of centrarchids, bullfrog adults, bullfrog tadpoles, and crayfish captured from backwaters of the 15-Mile and 18-Mile reaches (1999–2001).

Year	Centrarchids				Amphibians and Crustaceans		
	black crappie	bluegill	green sunfish	largemouth bass	bullfrog adults	bullfrog tadpoles	crayfish
1999	2	7	87	35	1	46	59
2000	0	8	46	0	1	7	4
2001	0	5	511	28	6	746	94

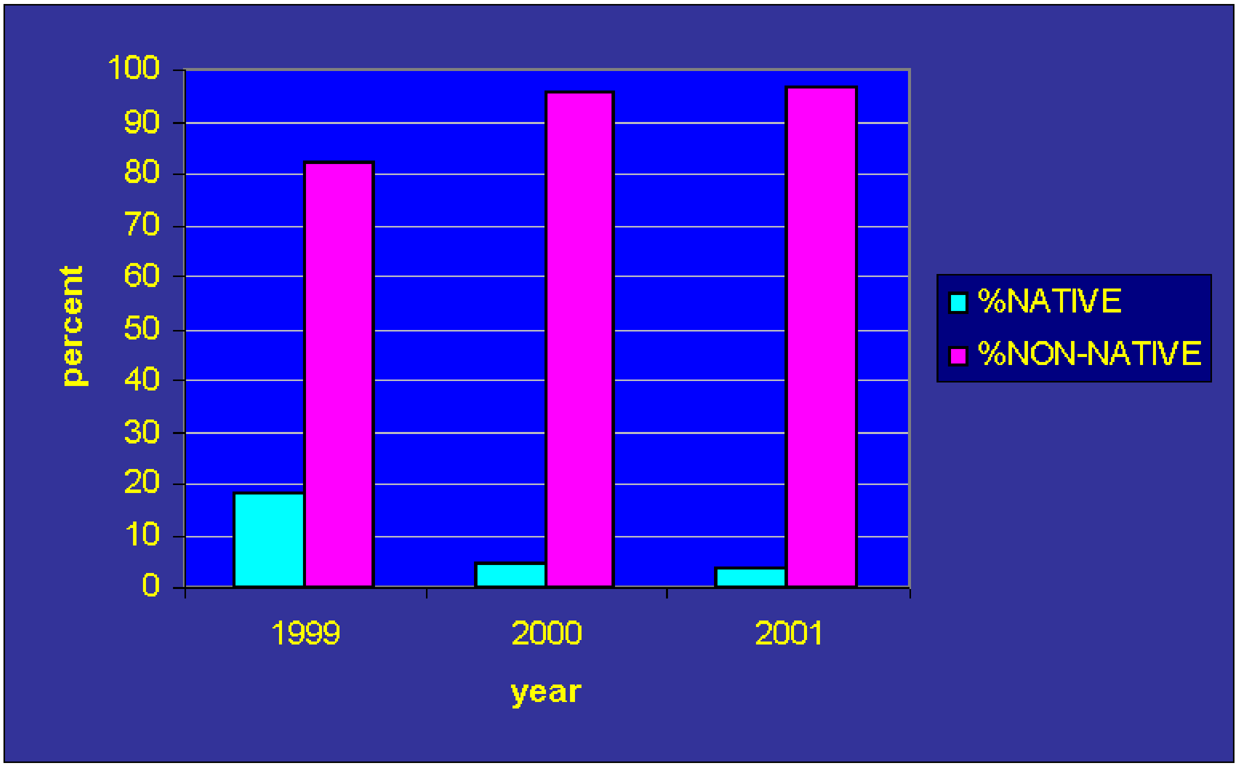


Figure 54. Ratio of native to nonnative fishes in backwaters of the Upper Colorado River (1999–2001).

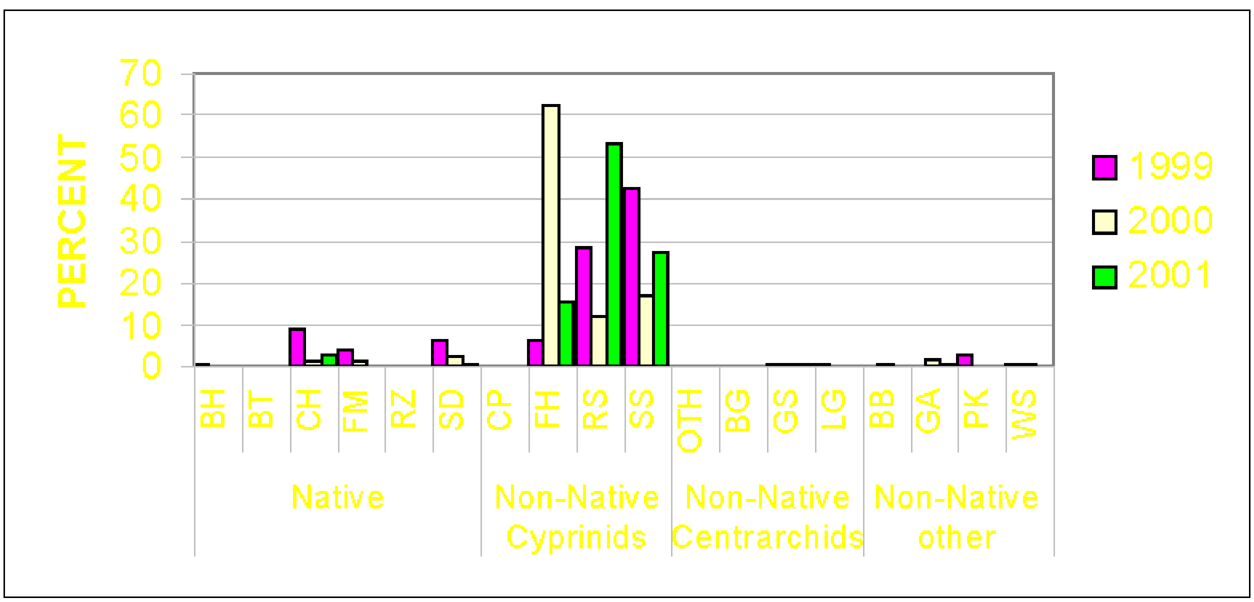


Figure 55. Species composition for backwaters sampled (1999–2001).

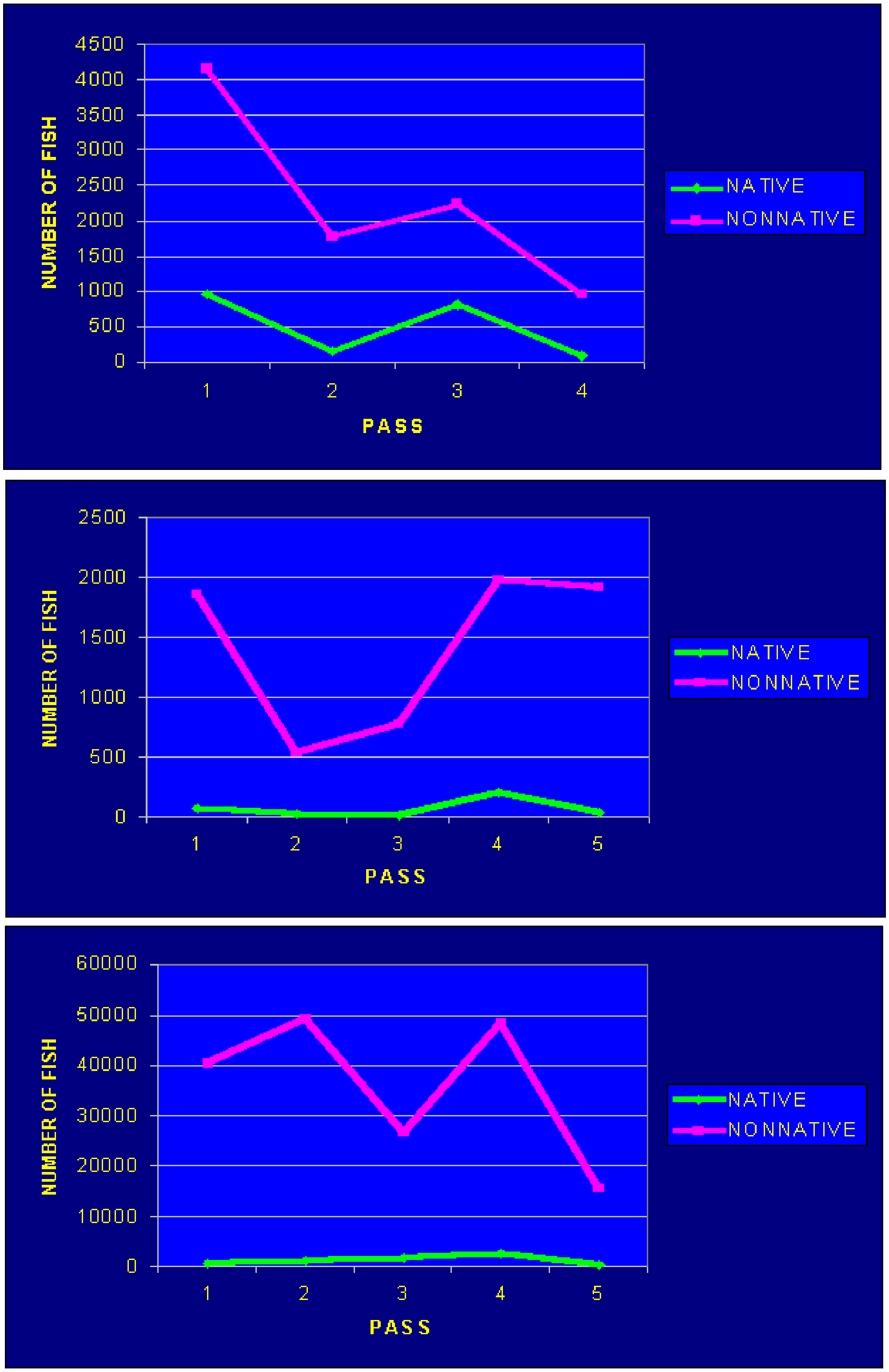
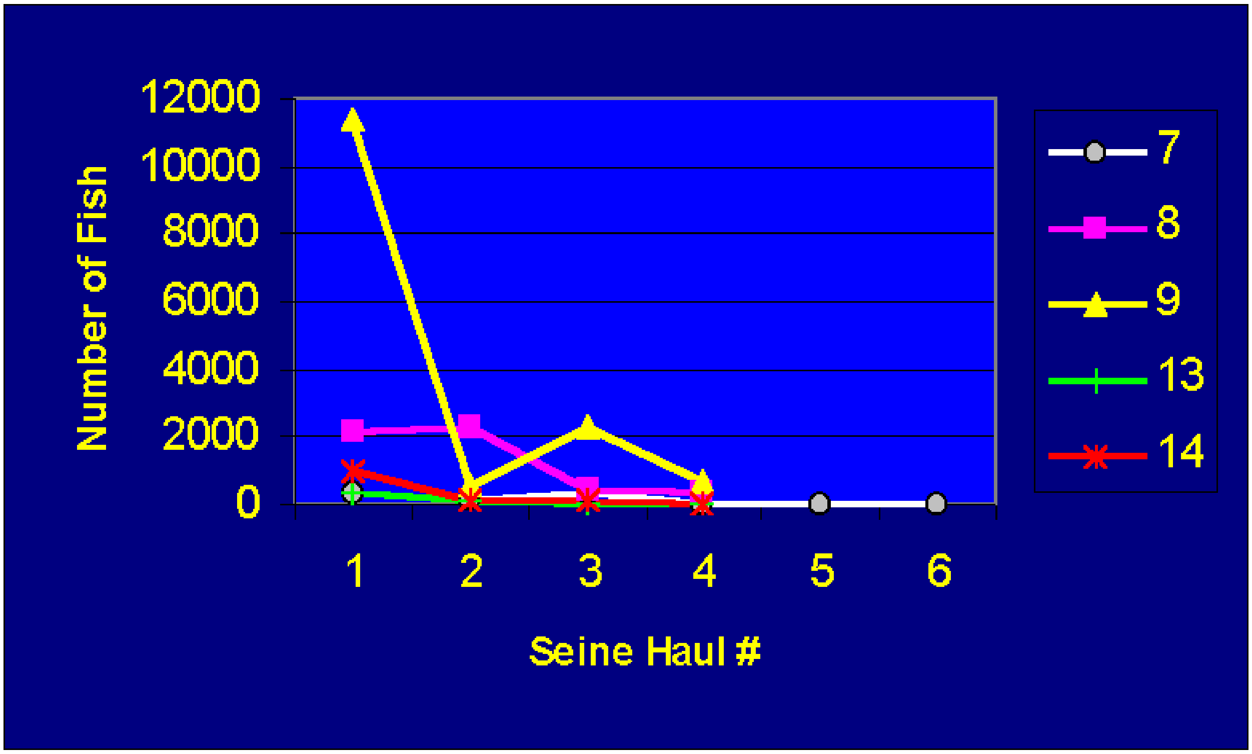


Figure 56. Total catches of native and nonnative fish for four or five passes (1999–2001).



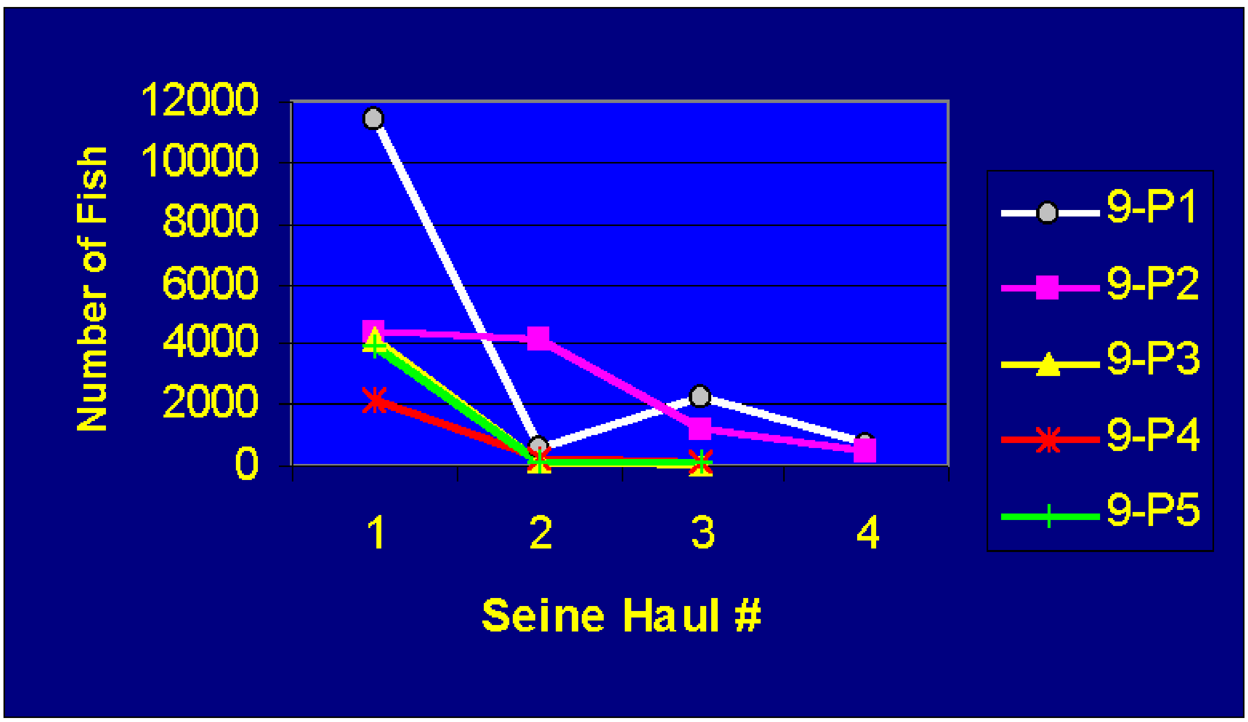


Figure 57. Numbers of fish captured from each of five backwaters with continuous seine hauls (top) and numbers of fish captured from backwater #9 for five trips.

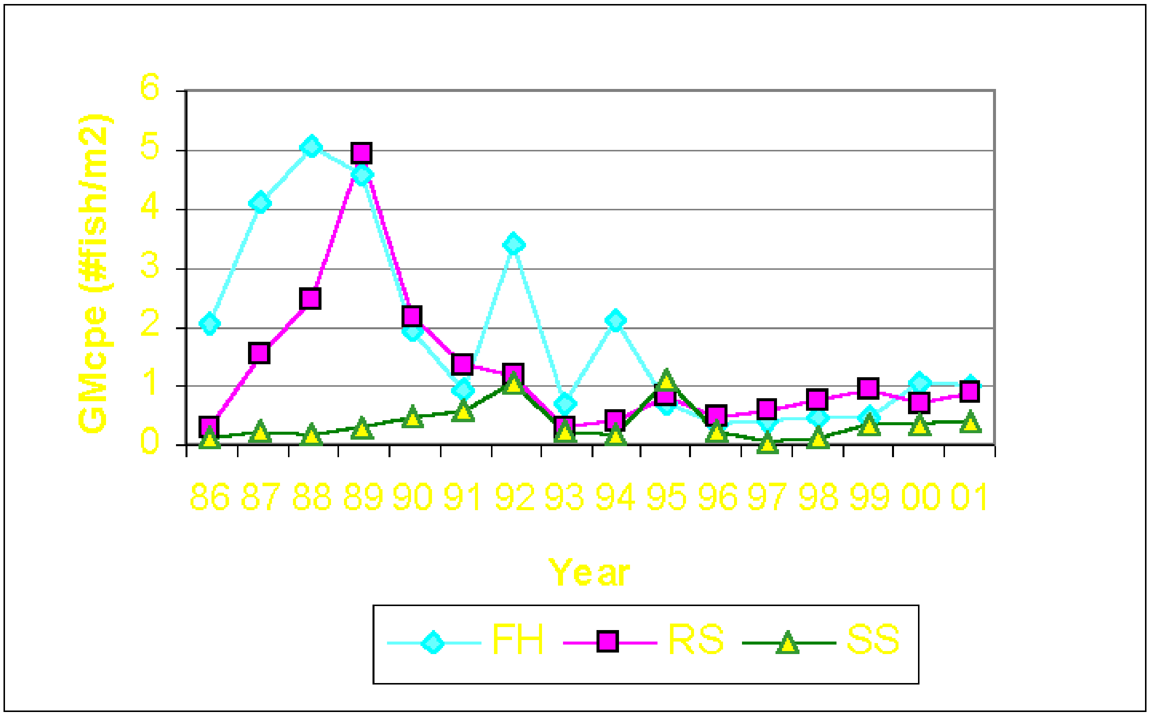


Figure 58. Geometric mean catch-per-effort for fathead minnow, red shiner, and sand shiner from Interagency Standardized Monitoring Program (ISMP).

4.0 DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The following is an expanded outline of conclusions and recommendations developed by the UCRRP as a result of information exchanged at the Nonnative Fish Control Workshop and interactions with researchers. Conclusions and recommendations are provided for different topics and/or RIPRAP projects.

I. General

I.A. Public Information and Education

Discussion.—The workshop participants agreed that public education needs to be increased and focused, especially with regard to highly visible nonnative fish control projects, such as the northern pike translocation in the Yampa River. It was agreed that it is best to have information go through one person to centralize all information and issue consistent statements and positions. The vehicle for getting this information to the public was not decided, but media available are the UCRRP newsletter, visits to school classes, local newspapers, and possibly television coverage.

Conclusions.—I&E efforts need to continue to improve to be more effective at targeting the various public groups with appropriate information on the intent, activities, and planning of the nonnative fish control. The nonnative fish control program is in the initial stages of development and evaluation, and the public needs to be advised and informed about the program.

Recommendation I.A-1.—Recovery Program's I&E Coordinator work with the I&E Committee and State and local entities (e.g., Yampa Basin Partnership) to improve the message and communications.

I.B. 1996 Nonnative Fish Stocking Procedures

Discussion.— Workshop participants discussed the need to demonstrate need and benefits of regulations for nonnative fish stocking and harvest. Fish stocking procedures were perceived to be complex and difficult to interpret in structuring regulations, and may need to be reevaluated. If clear regulations are established, enforcement will be very important. However, it can be difficult to discover and prosecute illegal stockings of fish regardless of the clarity and conciseness of regulations. An information and education (I&E) program is important to really get the public behind control of nonnative fish stocking. An important aspect of an I&E program might be to point out that illegal stocking can defeat multimillion dollar recovery program efforts and cost anglers millions in losses of desirable sport fish. Other states, such as Wyoming appear to have stricter regulations and enforcement of illegal stockings, but their effectiveness is supported by a considerable amount of public relations effort. Some participants asked if the program needs to more clearly define the impact of nonnative fish control for the public before moving ahead with currently planned control efforts.

Workshop participants also discussed potential conflicts between nonnative fish control and State valued recreational sport fisheries. An important issue to the State of Utah is management of tailwater trout fisheries, such as the Green River below Flaming Gorge Dam. This management area is not in direct conflict with the endangered fishes, because these occur further downstream. However, brown trout have moved downstream of the tailwater and occur in Lodore Canyon, a river reach with increasing numbers of endangered and native fishes since temperature modifications took effect at Flaming Gorge Dam in the mid-70's. Efforts to reestablish and maintain populations of humpback chub and Colorado pikeminnow in Lodore Canyon may require reduction of nonnative fishes, such as brown trout (brown trout have been reported as a major predator of humpback chub in Grand Canyon). Any announcement to control brown trout in Lodore Canyon could raise considerable public concern because of the perception that this action could also affect the tailwater fishery. Studies to determine the need to control brown trout and a strong I&E program would need to be implemented before initiating efforts to control the species in Lodore Canyon.

Participants also recognized the importance of an ongoing relationship between the UCRRP and the American Indian Tribes. Federal Trust Responsibilities, as well as Executive Order 110700 and Secretarial Order 3206 provide guidance for this ongoing communication with regard to endangered species issues. Most tribes have fish and wildlife advisory boards that provide liaison between State and Federal wildlife agencies and tribal councils. Workshop participants were reminded that despite claim of sovereignty, American Indian Tribes are very supportive of maintaining native fish communities and conservation of endangered species.

Workshop participants discussed National Park Service (NPS) policy for dealing with new invasions of nonnative species. Recently, yellow perch were discovered in Blue Mesa Reservoir. The NPS is currently evaluating the extent of the population to determine if control methods will be necessary and feasible. The need for special permits was brought out, and it was stated that permits for removing nonnative fish may be procured from specific park units, or a network-wide permit may be possible.

Conclusions.—The Nonnative Fish Stocking Procedures are too complex to be translated into understandable and enforceable State regulations. It is noted that in all nonnative fish control efforts, there is a need to demonstrate measurable effects of the action.

Recommendation I.B-1.—Revise the Nonnative Fish Stocking Procedures to simplify, clarify, and better reflect the current state of knowledge and proposed future direction of nonnative fish control efforts and regulations.

II. Pond Isolation and Rehabilitation

II.A. Colorado River Pond Reclamation (Project No. CAP-18/19; CDOW)

Discussion.— Workshop participants discussed at length the merits of the pond reclamation study (see section 3.2.1), and whether this strategy would result in a long-term reduction of nonnatives and a benefit to the endangered fishes. The researcher for that study pointed out that it may be necessary to reevaluate the idea of screening all pond outlets, because of the large number of ponds involved, the logistical difficulty of retrofitting screens to each one, and the difficulty and cost of maintenance. Instead, it may be prudent to identify and screen return flow irrigation drainage ditches and washes. This would reduce costs, logistics, maintenance, and the need to contact each individual pond owner. Many workshop attendees believe that ponds are a major source of especially nonnative cyprinids, and ongoing work is needed to minimize escapement into the main channel. It is especially important to identify those drainages ditches and washes that are sources of particularly problematic species, such as green sunfish or largemouth bass (probably about five in the 15-Mile and 18-Mile reaches). Some researchers also believe that these cyprinids are reproducing in the main channel, but the seasonal flooding of the river tends to keep their numbers down. The researcher also reminded everyone that nonnative larvae were documented passing through a 0.5-mm wedgewire screen, and so, screening will not block all movement of fish, but minimize numbers escaping.

The strategy of controlling nonnative fishes in riverside ponds was questioned by some. If ponds are reinvaded so quickly, there must be a large number of nonnative fishes in the river. If so, perhaps the program is wasting time and money on the ponds unless they are a primary source of nonnative fish. Current information does not answer this question—perhaps the population estimate work of the Colorado Division of Wildlife (see section 3.5.2) will provide information on mainstem fish communities. It was suggested that isotope analysis could be used to trace pond or river of origin for nonnative fishes in the river by looking for particular pond/river signatures. However, it is certain that riverside ponds are refuges for large numbers of nonnative fishes, and can provide a continual source for the mainstem. It was suggested that instead of a shotgun approach, the program should focus on a particular reach of river to see if we can have an impact on local nonnative fish populations. Even though there appears to be a large percentage of nonnative fish in the main channel, Colorado pikeminnow still seem to be able to recruit. Perhaps predation is a bigger issue for floodplain species. If so, perhaps the focus of pond reclamation should be to benefit razorback sucker. It is also pointed out that native fish in ponds do not appear to survive well in the presence of nonnative fish. However, it has been demonstrated that native fish grow and survive well in riverside ponds in the absence of nonnative fish. Hence, the role of riverside ponds may be transient use by native species (as nurseries for young or holding areas for adults during runoff), but refuges and major sources of nonnative species to riverine sections of critical habitat.

Conclusions.—Of the 335 ponds investigated to date, studies have shown rapid re-invasion of most reclaimed ponds by small cyprinids and green sunfish; limited use of sampled ponds by largemouth bass; and difficulty in maintenance and enforcement of maintenance of outlet screens.

Recommendation II.A-1.—Discontinue reclamation of individual ponds (except those identified in *Recommendation II.A-2)* as a Recovery Program scope of work.

Recommendation II.A-2.—Modify current scope of work to identify major source ponds/irrigation returns and place screens to minimize escapement of nonnative fishes to the mainstem Colorado River (see *Recommendation II.B-1)*; explore use of isotopes as an evaluation tool. Screen designs are available that prevent all large fish and most larvae from escaping, and require relatively little maintenance and allow for flood overflow. Anita Martinez (CDOW) has lead; she will work with U.S. Fish and Wildlife Service (USFWS) Grand Junction to identify "hot spots" as sources of predaceous centrarchids (especially largemouth bass); see *Recommendation V.A-2.*

II.B. <u>Evaluation of Nonnative Stocking Regulations (Project No. 106: CDOW)</u>

Conclusions: See II.A.

Recommendation II.B-1.—Reevaluate Colorado State regulations that require screening the outflows of individual ponds. In particular, enforce screening of the few large source ponds/irrigation returns identified in *Recommendation II.A-2.*

Recommendation II.B-2.—Revise State regulations to reflect changes in Nonnative Fish Stocking Procedures; see *Recommendation I.B-1*.

II.C. <u>Operation and Management of Large Wetland Depressions on the Ouray National Wildlife Refuge (Project No. CAP-6 OCW: USFWS-Vernal)</u>

Discussion.— A fundamental strategy of operating and managing large wetland depressions for native fishes in the upper basin is to maintain at least seasonal connection to the mainstem to allow for entrainment of naturally-produced larvae and escapement of surviving young, especially razorback sucker; this allows for natural completion of the life cycle of the species. An alternative strategy is that being practiced in the Lower Colorado River Basin, where numbers and species of nonnative fishes are greater and there are no wild riverine populations of razorback sucker; riverside ponds are isolated from the river and treated for complete removal of nonnative fishes before stocking with razorback sucker and/or bonytail. Concern with the upper basin strategy is the presence of large numbers of nonnative fishes in these open depressions, with little success of complete removal, and low apparent survival of young razorback sucker. Although the measure of success is unclear, it is noted that over a 3-year period (1999–2001), 100 razorback sucker were produced from Old Charlie Wash. Survival by even this small number of fish could mean an increase in the population of razorback sucker in the Green

River. It is also argued that removing the large nonnative fishes and leaving only the small-bodied fishes would narrow the predator window and allow razorback sucker to grown beyond predator-susceptibility more quickly. One potential strategy is to try to "reset" nonnative fish populations in floodplain habitats by draining after the second year, then drying and refilling.

Conclusions.—Based on results at Old Charlie Wash, it is feasible to remove large numbers and biomass of nonnative fishes from managed/controlled floodplain depressions, but the effects of this removal on main-channel fish populations is unknown.

Recommendation II.C-1.—Continue management of select floodplain depressions to enhance survival of early life stages of native fishes (especially razorback sucker).

Recommendation II.C-2.—If compatible with *Recommendation II.C-1*, include removal of nonnative fishes as a component of the management strategy for select floodplain depressions.

III. Reservoir Escapement Prevention Measures

III.A. <u>Highline Lake Screening Operation and Management (Project No. CAP-20; CDOW)</u>

Discussion.—The researcher stated that this type of netting is a suitable solution for reservoirs of this type. He acknowledged that there may be a cost/benefit issue at some places. Participants agreed that the block net at Highline Reservoir was effective. Net Replacement will cost around $150,000 each time; the estimated net life is around 3–5 years. The initial cost of the project was $384,000.

Conclusions.—Studies have shown that the Highline Lake Fish Barrier Net is effective at minimizing escapement of nonnative fishes from Highline Lake.

Recommendation III.A-1.—Continue to maintain and monitor the Highline Lake Fish Barrier Net.

Recommendation III.A-2.—Based on the amount of deterioration in net strength since installation in 1999 (about 33%), Recovery Program will need to consider replacement of the net over the next 1–2 years.

IV. Northern Pike Removal

IV.A. Translocation of Northern Pike from Critical Habitat in the Yampa River (Project No. 98; CDOW, Larval Fish Laboratory/Colorado State University)

Discussion.—Based on data collected in 2000, population estimate for northern pike in Yampa River was approximately 959–2,067 fish. Workshop participants agreed that an information and education program is needed because of the existing public relations issues having to do with translocation of northern pike; this includes agency people. There is also a need to develop better relationships among agencies, landowners, anglers, and the affected communities. Participants emphasized the need to develop a way to evaluate effectiveness of the translocation effort. It was also pointed out that there is a large source of northern pike upstream of the removal area that serves as a source of fish.

Conclusions.—Removal/translocation efforts on northern pike to date have received positive public feedback; data suggest depletive effects in habitats sampled over the sampling period, but average size of northern pike and incidence of attacks on Colorado pikeminnow have increased. Implementation of a bounty reward for northern pike removed through recreational angling may have potential.

Recommendation IV.A-1.—Continue removal and translocation of northern pike from critical habitat in the Yampa River (i.e., downstream of Craig, Colorado, to Dinosaur National Monument).

Recommendation IV.A-2.—Plan and prepare for removal and translocation of smallmouth bass and channel catfish during northern pike translocation (potentially implement smallmouth bass and channel catfish removal/translocation at some level in 2002).

Recommendation IV.A-3.—Explore the possibility of implementing a bounty on northern pike, and if feasible, implement.

IV.B. Fish Community Population Estimates on the Yampa River (CDOW)

Discussion.—The researcher pointed out that smallmouth bass could be a bigger problem than northern pike in the Yampa River. Smallmouth bass feed on small-bodied fishes and use shallow water habitats; they also do well in fast-flowing reaches. It was pointed out that effects of smallmouth bass on native fishes needs to be assessed to determine if a control program is necessary and the best mechanism for implementing such control. The researcher stated that low-flow years may provide the best potential for nonnative control because of easier access and sampling conditions. These are also the years with the greatest potential for competitive effects on native fish.

Conclusions.—There have been substantial increases in smallmouth bass populations.

Recommendation IV.B-1.—Continue population estimates of fishes in the Yampa River and, where feasible, use those efforts and results to help assess effects of removal/translocation.

IV.C. Translocation of Northern Pike From the Upper Yampa River (upstream of Craig, Colorado) (Project No. 98a; USFWS-Grand Junction)

Discussion.—The researcher noted that a high percentage of northern pike captured from two short reaches around Hayden, Colorado, appeared to be ripe during the early part of the study. These fish measured 30–110 cm; most were in the 50–80 cm range. It is uncertain if removal of fish earlier in the year would be more effective to key in on spawning areas. It was pointed out that the Service did not conduct I&E efforts because it was not their responsibility. It was noted that the Yampa River partnership was notified, the information was not well-disseminated. Hence, public relations issues persist with the Yampa River translocation project and need to be addressed. Data indicate that northern pike removal should continue, but the program needs to convince anglers that:

- we can control northern pike through removal efforts;
- northern pike might deplete forage base if not controlled;
- northern pike might be affecting the recruitment of Colorado pikeminnow; and
- this removal was only for a small area and expansion to larger area may be needed.

Conclusions.—Removal/translocation efforts in 2001 have received positive public feedback; data suggest depletive effects in habitats sampled over the sampling period. Implementation of a bounty reward for northern pike removed through recreational angling may have potential.

Recommendation IV.C-1.—Continue removal and translocation of northern pike from established the upper Yampa River sites (upstream of Craig, Colorado). Coordinate with northern pike exclusion assessment (Project No. CAP-31) to prevent confounding effects on exclusion study.

Recommendation IV.C-2.—Plan and prepare for removal and translocation of smallmouth bass during northern pike translocation (potentially implement smallmouth bass and channel catfish removal/translocation at some level in 2002).

Recommendation IV.C-3.—Explore the possibility of implementing a bounty on northern pike, and if feasible, implement.

IV.D. Removal of Northern Pike from the Gunnison River (Project No. 58; USFWS-Grand Junction)

Discussion.—Removal of northern pike from the Gunnison River was a very limited effort in response to a small number of northern pike observed in the Gunnison River. The removal program seems to have been effective at reducing the number of northern pike in the river. Northern pike in the Gunnison River is not a major issue at this time. Northern pike could be controlled by removing the fish while sampling for other projects. Habitat for northern pike is more limited than in the Yampa River, and no specific effort is needed to remove northern pike from the Gunnison River. New flow recommendations for the Gunnison River shouldn't substantially change habitat availability for northern pike.

Conclusions.—Fish sampling conducted in the Gunnison River downstream of Hartland diversion since 1996 has not collected northern pike, suggesting that efforts during 1995–1996 to remove the species from this river reach were successful.

Recommendation IV.D-1.—Remove northern pike as encountered from the Gunnison River as part of fish population monitoring and research. No specific removal or translocation project is required.

IV.E. Development of Northern Pike Control Program in the Middle Green River (Project No. 109; UDWR-Vernal)

Discussion.—Northern pike in the Middle Green River were found mostly in larger backwaters and tributary mouths in the Jensen area. The question was asked if the program can set criteria to determine which northern pike removal efforts should be identified and implemented. At this time, the criteria for removal is to focus sample efforts on the concentration areas. There does not currently appear to be any reproduction of northern pike in the Green River; however, some ripe fish have been collected. It appears that northern pike in the Green River have moved downstream from the Yampa River. The researcher stated that the project should be able to better assess the northern pike situation in the Green River following sampling in 2002. Movement of northern pike into the Green River brings concerns relative to stocking of razorback sucker. The researcher did not see justification for changing the sampling approach.

The question was asked if the intensity of the work in the Yampa River is great enough. Northern pike removal in the Yampa River will continue for now. CDOW might consider a bounty within non-critical habitat area of the Yampa River as a way to get support from local anglers. The UDWR representative noted that a bounty in Colorado could cause reaction among anglers in Utah also wanting a similar bounty system in that State. The question was also asked of how might continued presence (insufficient removal) of northern pike affect "sufficient progress" determination for the Yampa River. CDOW pointed out that the number of Colorado pikeminnow in the Yampa River seems to be increasing, although there seems to be a possible shift in size distribution. The

USFWS representative noted that northern pike can be effectively removed from some areas pretty quickly and the crews may be able to spend less time in those areas next year; he would like to continue efforts to better evaluate effectiveness of the removal. It was pointed out that the Yampa River Partnership could be asked to be more active in conveying issues to the public. It was noted that a graduate student will be doing some evaluations of northern pike removal in the Yampa River, and concern was expressed over potential conflict among studies if not coordinated. The graduate study will involve an exclosure approach as a viable strategy for controlling northern pike in some areas.

Conclusions.—Removal methods used in 2001 appear to be appropriate.

Recommendation IV.E-1.—Continue mechanical removal of northern pike from the middle Green River (Island Park to confluence of White River).

Recommendation IV.E-2.—Target flooded areas and tributary mouths (e.g., Cliff Creek, Ashley Creek, Duchesne River, White River) in early spring (April, May, June) to remove northern pike, as well as smallmouth bass, channel catfish, carp, green sunfish, black crappie, bluegill, walleye.

V. Centrarchid Removal

V.A. Electrofishing Removal of Non-Native Fish From Nursery Habitats in the Upper Colorado River (Project No. 89; USFWS-Grand Junction)

Discussion.—The question was asked if there was any indication if flow regime had an effect on centrarchid numbers. A response was not available. It was noted that gravel pit ponds were not sampled in this study, but small isolated depressions and some beaver ponds were sampled, as well as isolated backwaters. Although depletion effects have not been demonstrated with problematic centrarchids, such as green sunfish or largemouth bass, it was suggested that “hot spots” (i.e., large concentrations of fish and/or key spawning areas) should be identified and control implemented at these. These removal efforts should be dovetailed with the screening/reclamation efforts of ponds and primary canals. Widespread centrarchid removal seems unnecessary and should be discontinued. Perhaps an additional bass control workshop would be useful. The public perception is that cyprinids are more of a problem than centrarchids. In reality, the centrarchids might be capable of being a bigger drain on native fish populations. Repeated collections to control cyprinids in backwaters used as nursery habitats by native species might have a negative effect on native fish survival and recruitment. It was suggested that a control treatment used in a given year might need to be coordinated according to the type of water year. It was also noted that certain types of hydrology may help suppress nonnative fishes. It is hypothesized that flows can disrupt habitat and suppress nonnative fish populations. Some Workshop attendees mentioned that sufficient broad control of certain small-bodied nonnatives in some river reaches may be achieved through providing flow regimes required by the endangered fishes; however, this idea was not referenced in the papers presented and was not a group conclusion.

Conclusions.—Studies to date did not show a measurable, lasting reduction in nonnative populations through mechanical-removal efforts; treatment areas were rapidly re-colonized. No alternative methods were identified that would potentially improve chances for successfully reducing nonnative populations through mechanical removal.

Recommendation V.A-1.—Do not proceed with large-scale efforts to mechanically remove nonnative fishes (especially centrarchids) from backwaters and other low-velocity habitats used as nurseries by native fishes.

Recommendation V.A-2.—Identify "hot spots" as sources of predaceous centrarchids (especially largemouth bass), and implement measures to minimize escapement to the main channel, as necessary, including screening. See *Recommendation II.A-2.*

V.B. <u>Fish Community Population Estimates on the Upper Colorado River (CDOW)</u>

Discussion.—There was a difference in population structure between years of the study. Years had different flow regimes, and it was believed by the researcher that this may be indicative of a carrying capacity effect. However, the multiple variables involved make it difficult to assess results. It was noted that low flow years may have best potential for control of nonnative fishes. These are also the years with the greatest potential for competitive effects. It was pointed out that there were three overlapping projects sampling and/or removing fish from the same area (Anderson, Osmundson, Valdez); need to see that the studies take each other into account when evaluating results.

Conclusions.—Population estimates did not show depletive effects from centrarchid removal efforts.

Recommendation V.B-1.—Continue population estimates of fishes in the Upper Colorado River and, where feasible, use those efforts and results to help assess effects of control measures.

VI. Channel Catfish Removal

VI.A. <u>Non-Native Fish Removal Efforts in the Middle and Lower Green River (Project No. 59; UDWR-Moab)</u>

Discussion.—Fyke nets were effective at capturing smaller fish and some differences were noted between years. It was noted that it was best to collect channel catfish during August and September. Primarily smaller channel catfish were noted in the lower Green River, but there was no detectable decrease as a result of the removals. UDWR was asked if they will implement widespread channel catfish control in the Green River. It is anticipated that channel catfish control will be implemented in areas of concentrations and/or of significance to native species. It was pointed out that channel catfish control would probably best be implemented in Desolation/Gray canyons, not in the part of the river sampled in the study. Recovery goals call for channel catfish control to be considered in Desolation/Gray canyons.

Conclusions.—Studies to date did not show a measurable, lasting reduction in channel catfish populations through mechanical-removal efforts targeting young fish. No alternative methods were identified that would potentially improve chances for successfully reducing channel catfish populations through mechanical removal of young fish. Desolation/Gray canyons is a suspected spawning reach for channel catfish because of the abundance of large boulders and crevices used by cavity spawners.

Recommendation VI.A-1.—Do not proceed with large-scale efforts to mechanically remove young channel catfish in the middle and lower Green River.

Recommendation VI.A-2.—Implement removal of channel catfish in Desolation/Gray canyons using fyke nets to target subadults, and electrofishing to target large adult spawners. Also consider angling as a capture method.

VI.B. Development of a Channel Catfish Control Program in the Lower Yampa River Within Yampa Canyon (Project No. 110; USFWS-Vernal)

Discussion.—This study suggests that spawning of channel catfish in the Yampa River occurs in upper reaches and fish move downstream into Yampa Canyon. Analyses suggest that channel catfish move from/into Yampa Canyon during different seasons. This is supported by the observation that many channel catfish larvae have been collected in drift nets in the Yampa River. It was suggested that the control program target the large spawners in the Yampa River as a primary means of control. Control should target large adult channel catfish moving through Yampa Canyon on their way to spawning areas upstream.

Conclusions.—Data indicate that angling and electrofishing are effective methods for reducing channel catfish numbers in Yampa Canyon. Yampa Canyon is a suspected spawning reach for channel catfish because of the abundance of large boulders and crevices used by cavity spawners. It is known that young channel catfish produced in the Yampa River (and other tributaries) disperse downstream into the mainstem Green River, then likely migrate back to the tributaries as subadults to recruit into adult populations.

Recommendation VI.B-1.—Continue removal of channel catfish in Yampa Canyon by angling and electrofishing.

Recommendation VI.B-2.—Use fyke nets at upper end of Yampa Canyon to intercept and remove adult channel catfish migrating downstream into Yampa Canyon to spawn.

Recommendation VI.B-3.—Use fyke nets (and possibly angling) at lower end of Yampa Canyon to intercept and remove subadult channel catfish migrating upstream into Yampa Canyon to recruit into the adult spawning population.

VI.C. Development of Channel Catfish Control Programs in the Duchesne, White, and Colorado Rivers

Discussion.—Workshop participants noted that nonnative fish control efforts could be very effective at concentrations areas, such as the mouth of the Duchesne River and in the White River. The CDOW is currently working with Northwestern Colorado Community College to assist with channel catfish removal above Kenney Reservoir on the White River. Channel catfish seem to move into the White River, but recruitment/spawning areas are unknown. It was also noted that there are many smallmouth bass, walleye, channel catfish, green sunfish, etc. concentrated at the mouth of the Duchesne River. It was pointed out that there are potential tribal issues that need to be resolved before attempting any removal efforts in the Duchesne River.

Conclusions.—The group expressed the potential need for channel catfish control programs (similar to those recommended for the Yampa River and Desolation/Gray canyons) in portions of the Duchesne, White, and Colorado rivers.

Recommendation VI.C-1.—Identify the need for channel catfish control programs in the Duchesne, White, and Colorado rivers, and develop control strategies using programs in the Yampa River and Desolation/Gray canyons as templates.

VII. Small-Bodied Fish Removal

VII.A. Mechanical Removal of Non-Native Cyprinids in the Lower Green and Colorado Rivers, Utah (Project No. 87a; UDWR-Moab)

Discussion.—The question was asked if there is any hope for removal of nonnative cyprinids. The response was that it does not appear that mechanical removal will be effective. It was observed, however, that population structure differed during the study, as well as densities of fish between 1999 and 2000. It was noted that this shift in structure and density of nonnative cyprinids could be flow/hydrology effects on catch and habitat availability. Some Workshop attendees mentioned that sufficient broad control of certain small-bodied nonnatives in some river reaches may be achieved through providing flow regimes required by the endangered fishes; however, this idea was not referenced in the papers presented and was not a group conclusion.

Conclusions.—Studies to date did not show a measurable, lasting reduction in nonnative cyprinid populations through mechanical-removal efforts; treatment areas were rapidly re-colonized. No alternative methods were identified that would potentially improve chances for successfully reducing nonnative cyprinid populations through mechanical removal.

Recommendation VII.A-1.—Do not proceed with large-scale efforts to mechanically remove nonnative cyprinids from backwaters and low-velocity habitats in the lower Green and Colorado rivers in Utah.

VII.B. Non-Native Fish Control in Backwater Habitats in the Colorado River in Colorado (Project No. 87b: CDOW, SWCA)

Discussion.—Similar conclusions were reached with this study as with the study on the Green River that mechanical control appeared to have little or no effect at reducing numbers of nonnative cyprinids. Variations in age structure and densities of fish were noted, and were attributed to variations in flow regime as well as environmental variables, such as temperature (e.g., late or early warming of the river in spring affects spawning of these fishes). Some Workshop attendees mentioned that sufficient broad control of certain small-bodied nonnatives in some river reaches may be achieved through providing flow regimes required by the endangered fishes; however, this idea was not referenced in the papers presented and was not a group conclusion.

Conclusions.—Studies to date did not show a measurable, lasting reduction in nonnative cyprinid populations through mechanical-removal efforts; treatment areas were rapidly re-colonized. No alternative methods were identified that would potentially improve chances for successfully reducing nonnative cyprinid populations through mechanical removal.

Recommendation VII.B-1.—Do not proceed with large-scale efforts to mechanically remove nonnative cyprinids from backwaters and low-velocity habitats in the Colorado River in Colorado.

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